Overreaction of Equity and Fixed Income ETF during the 2007/2008 Financial Crisis

by

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Abstract

The financial crisis of 2007/2008 is considered one of the most important event in the history of financial markets, leading to a significant change in the perspective of investors. Since then, investors look to mitigate their exposure to credit risk, given preferences for instruments like exchange traded funds (ETF) which are characterized by low credit risk. Therefore, ETF markets have been growing significantly since the financial crisis. Together with this growth, increases the relevance of studying the price dynamics experienced by this market. With this study, we intend to make an additional contribution in this topic through the analysis of the equity and fixed income ETF market in the US. More specifically, we study the patterns of overreaction of the equity and fixed income ETF markets in the period 2007-2014. Moreover, as far as we know there are not studies approaching overreaction on fixed income ETF market. In a complementary basis, we also analyse financial crisis and recovery periods as well as bull and bear market periods, separately. Overall, we found higher degree of overreaction during the periods in which the market is closed (after-hours periods) than during market sessions which could be justified by the lower liquidity level and the proportion of informed traders to noise traders in after-hours periods. We also found significant differences between financial and recovery periods as well as between bull and bear market periods. However, it is important to point out that such results could be influenced by the unique period on financial market history approached. On the other hand, overreaction is inferred based on the first 24 hours following the extreme price movements occur, longer reversals are not captured by this study. Regarding fixed income market, a low development level could also influence the results obtained. Forthcoming analysis using other time range and other regional markets could be relevant for this topic.

Key-words: Exchange Traded Funds; Overreaction; Behaviour Finance; Efficient Market Hypothesis; Financial Crisis

JEL-code: G12, G11, G14

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1. Introduction

The global financial crisis emerged in 2007 and has been followed by a deep recession in many countries around the world. The genesis of this crisis was the credit boom, followed by the meltdown of sub - prime mortgages and securitized products challenged the financial system health. During this unique event, volatility of financial markets increased to the highest levels ever seen. Consequently, investors became more defensive and aware to credit risk.

In this context, the *risk off* environment presented on the market promoted the development of instruments characterized by low volatility and low credit risk, such as exchange traded funds (ETF). Like mutual funds, these instruments are composed by wide index of securities as their underlying. Moreover, ETF are traded as a unique security on a stock exchange which constitutes an important factor of differentiation. Investors are able to be long or short of an entire portfolio with reduce costs by trading a single security. Nevertheless, ETF shareholders are subjected to management fees by the issuer, which reduce the potential return (Elton *et al*., 2002).

The first US equity ETF appeared in 1993, three years later of the first equity ETF which appeared in Canada, while the first non-equity ETF only appeared in 2000 in Canada and 2002 in US, so almost 10 years later the first equity ETF. Nowadays, in addition to equity and fixed income ETF there are also commodity and currency ETF.

Currently, ETF industry represents about $3.1 trillion assets under management globally with US market representing 74% of the global ETF industry, while Europe and Asia comprise 17% and 9%, respectively. Regarding fixed income ETF market, it represented, in 2016, $605 billion asset under management, while in 2008 it represented less than $100 billion. Equity ETF shows the greatest market share with 75% of the global ETF market, following by fixed income, commodity and currency ETF. (JPMorgan, 2016)

In further accordance with JPMorgan (2016), US-listed ETF industry represents about $2,2 trillion in asset distributed across 1,854 ETF, about 9.6% of total US equity market. In respect to US fixed income ETF market, it represents $383 billion assets under management.

As referred before, financial crisis was a turning point for this market. During such period, equity ETF represented almost 50% of the total equity trading volume in U.S. market

with investors opted for these instruments to protect themselves from volatility presented on the market.

Over the years, new opportunities and new challenges for investors and regulators emerged. Thus, this industry raise interest among investors and financial researchers.

This dissertation studies the patterns of overreaction of equity and fixed income ETF since 2007 to 2014 in the US market. In order to understand the impact of financial crisis on this market, we also study the financial crisis period and the subsequent recovery period, individually. Furthermore, as an extension to that analysis we divide the analysis period according to market sentiment: bull and bear market periods.

Within the two markets approached in this study (equity and fixed income ETF), further market distinctions by ETF type may be made, namely sector, international and broad-based ETF. While sector ETF focuses on one specific sector, international ETF is composed by foreign securities and broad-based ETF is a well diversify index which intends to reflect the movement of the entire market. Among them, international ETF is quite popular since it allows an exposure to international instruments that for an active investor would be difficult to replicate.

Regarding this issue, studies on financial literature are few. So, this study intends to be, in part, an additional contribute for the analysis of equity market's price dynamics. Concerning fixed income ETF market, as far as we know, there are no other studies approaching this issue. It is also one aim of this study to be a first contribute for the analysis of fixed income market's returns. It is important to notice that this analysis focuses on the beginning of fixed income market development, further studies may be conducted in periods with greater liquidity in order to understand if market continues to follow the same trends.

This analysis is also relevant for investors in order to acquire further knowledge and making the right investment decisions according to their profile.

The results show a significant difference of patterns of overreaction between market open hours and after-hours periods. These differences are observed in fixed income and equity markets. We also observe, in some cases, a different behaviour of international ETF when comparing to other types, suggesting some delay on the incorporation of relevant information on price. On the other hand, we conclude a higher level of overreaction during financial crisis, mainly on equity market. Also, from the comparative analysis of bull and

bear market periods we can conclude that investors' sentiment seems to play a relevant role on ETF's price dynamics.

Besides this chapter, this dissertation is structured as follows: in chapter 2 is presented the literature review about this subject, previous researchers and different views about returns on the market and evolution of ETF prices. Chapter 3 presents data description, empirical research of this dissertation and the methodology followed. Afterwards, results could be consulted in the chapter 4. Finally, the conclusion of this dissertation is presented in chapter 5.

2. Literature Review

Over the years, ETF industry has been experiencing an exponential growth reaching more $3tn under asset management in 2016 (JPMorgan, 2016). From the beginning in 1990, this industry is suffering a huge evolution emerging new and more complex instruments.

The overreaction phenomenon on financial markets has been widely explored by diverse researchers. However, there are few studies approaching overreaction on ETF equity market. Additionally, as far as we know, there are no studies about overreaction on ETF fixed income market. Therefore, the present analysis becomes a relevant contribute for this issue.

In this chapter, we explore the wide literature approaching overreaction phenomenon by Efficiency Market Hypothesis and Behavioural Finance. Afterwards, we explore the existing literature approaching ETF returns and overreaction.

2.1. Overreaction and Efficiency Market Hypothesis

The overreaction of securities' price has been widely discussed in the financial literature. According to Efficiency Market Hypothesis (EMH), the price of securities reflects their fundamental value, assuming that all investors are rational. Therefore, investors are not able to obtain any profit above the normal return using the available information since it is already reflected on price. Any deviation from securities' fundamental value is eliminated in a short period of time through arbitrageurs' activity. They act in the opposite to irrational movements on prices until price reflects securities' fundamental value. Once the past information was already incorporated, only the present information could impact the security price. Furthermore, market returns are totally randomly and impossible to predict.

"A market is efficient with respect to information set αt if it is impossible to make economic profits by trading on the basis of information set αt." (Jensen, 1978, pp.3).

Nonetheless, in financial market we observe anomalies, such as overreaction or momentum effect, which challenge EMH. Deviations of the price from security's fundamental value require a deep analysis being the relation of over - or underreaction with lack of efficiency on the market not clear. The market efficiency concept incorporates some

individually and unanticipated events that could be responsible for over- or underreaction of instrument price (Brown and Warner, 1980).

> "*If anomalies split randomly between underreaction and overreaction, they are consistent with market efficient*."(Fama (1998), pp.284).

EMH also states that long term reversals should not be consider anomalies: "covariation among long term losers seems to be associated with risk premiums that can explain the higher future average return than long-term winners" (Fama (1998), pp.287).

Such anomalies have been also object of study by behaviour finance researchers, who defends the existence of consistent anomalies in the market. According to behavioural finance theories, prices tend to over-response new information, allowing price deviations from securities' fundamental value in short term. Following such movement, it is expected a reversal movement in order to readjust the price to fundamental value. Hence extreme positive movement may experience a negative return in a short-term, as well as negative extreme movements may be following by a positive return. (DeBondt and Thaler, 1985).

Moreover, according to Caginalp *et al*. (2000), overreaction could be explained by variations in "liquidity, short-selling, certainty or uncertainty of dividend payments, brokerage fees, capital gains taxes, buying on margin, and others" (pp.24).

Behavioural finance theories are an important contribution to understand such phenomenon. Overconfidence theory developed by Odean (1998) defends that the presence of overconfident investors has influence on the market. "When there are many overconfident traders, markets tend to underreact the information of rational traders. Markets also underreact to abstract, statistical, and highly relevant information and overreact to salient, but less relevant information." (Odean (1998), pp.1916).

On the other hand, investors tend to overweight recent movements of the price in detrimental to securities' fundamental value, according to feedback theory. (Cutler*et al.*, 1990). Based on the last movements, investors tend to invest in winners stocks making the price deviate more from their fundamental values. (DeBondt and Thaler, 1990).

These theories are in line with representativeness bias theory, developed by Kahneman and Tversky (1974). According to this theory, people overestimate the probability of recent

patterns observed on the market and underestimate the future perspective of the asset, which EMH defends as being the only aspect that influences the prices.

Additionally, momentum effect developed by Jegadeesh and Titman (1993) enhance some psychology aspects with impact on prices beside security's fundamental value. They defend the existence of some patterns and tendencies that investors usually follow, so the market presents some persistently anomalies.

The following sentence by Barberis and Thaler (2003, pp.1053) describes briefly the view of behavioural finance:

"Behavioural finance argues that some financial phenomena can plausibly be understood using models in which some agents are not fully rational. The field has two building blocks: limits to arbitrage, which argues that it can be difficult for rational traders to undo the dislocations caused by less rational traders; and psychology, which catalogues the kinds of deviations from full rationality we might expect to see."

Over the years, market overreaction has been approached by several empirical studies on finance literature. Atkins and Dyl (1990) were one of the first researchers concluding that losers earns on average positive returns on the next day. Also, Bremer and Sweeney (1991) suggested that after extremely large negative returns, securities tend to experience more than expect positive returns over the following two days. Cox and Peterson (1994) studied daily returns of NYSE, AMEX and NMS from January 1963 until June 1991. They found significant reversals on short-term following extreme price movements equals to, at least, 10%. However, the degree of reversals wanes through time suggesting that short term overreaction tends to disappear with greater liquidity on the market. Larson and Madura (2003) studied the same market between 1988 and 1995 concluding that both positive and negative extreme returns experienced great negative abnormal returns on the following days. In contrast to these studies, Sturm (2003) did not find a significant reaction after negative price shocks.

In further accordance with behavioural financial, the existence of noise uniformed traders increases price volatility and anomalies. As suggested by De Long *et al.* (1990, pp-705), "the unpredictability of noise traders' future opinions deters arbitrage, prices can diverge significantly from fundamental values even when there is no fundamental risk". Also,

lower trading volume on the markets may lead with greater inefficiencies since there are less rational traders (informed traders) increasing the possibility of mispricing (Cox and Peterson, 1994, Daniel *et al*. (1998)). Richards (1997) concluded greater degree of overreaction on higher volatility markets.

Nowadays, market liquidity is increasing which result in lower transaction costs. It may reduce the number of anomalies occurred as well as the profitability of such anomalies. (Chordia *et al*., 2014). Notwithstanding, it is important to distinguish between market open hours and when the market is close. According to Barclay and Henddershot (2004), after-hours market is less liquid than market open hours with, on average, higher transaction costs. Thus, spreads are three to four times larger on after-hours market. Assuming rational investors look for lower expensive moment to execute their trades, they concluded that after-hours market has a higher proportion of uninformed to informed traders comparing to market session hours.

Finally, the growth popularity of hedge fund assets has a positive impact with the decline of anomalies, increasing the efficiency of the market. (Chordia *et al*., 2014).

2.2. ETF and market efficiency

As referred previously, this industry is relative recent with a huge evolution since financial crisis. For this reason, overreaction on ETF market is not a common topic approached by researchers, thus these studies are scarce.

An important factor is the liquidity on ETF market, particularly in fixed income market. More liquid instruments are less susceptible to misprice. In case of low liquid instruments, the probability of misprice is higher because there are few investors trading such instruments. (Madura and Richie, 2010)

Additionally, different ETF types may show different returns behaviour. International ETF may present higher standard deviation from their net asset value comparing to others and greater propensity to overreaction. It could be explained by the lower liquidity, more complex arbitrage mechanisms, higher transaction costs and the exposure of this type of ETF to other factors for which information is less readily available. On the other hand, sector ETF tends to be the less diversified type with exposure to specific risk while broad-based ETF

may be less susceptible to mispricing and consequence overreaction, in this case the arbitrage process tends to be more efficient (Madura and Richie (2010); Engle and Sarkar (2006)).

According to EMH, instruments should reflect all available information and some mispricing may be quickly eliminated on the market. However, Fulkerson *et al*. (2014) showed that mispricing on ETF market tends to persist for periods of thirty days which suggests some level of inefficiency on the market with no quickly adjustment when net asset value changes. Thus, investors can take advantage from such ETF misprice. The researchers defended that this mispricing may be explained by a mismatch in timing of net asset value calculation and ETF closing prices or cash creation/redeem fees (Fulkerson *et al*., 2014; Madura and Richie, 2010; Rompotis, 2011).

Madura and Richie (2010) studied patterns of overreaction of equity ETF during the bubble of 1998-2002 and concluded the existence of overreaction during this period. They found a "substantial reversals on average which implies a correction to investor overreaction". Moreover, such reversals are "consistently more pronounced for ETF that experience more extreme stock price movements". Regarding ETF types, they concluded a more pronounced reversal on international ETF. According to researchers informed traders take advantages from those who are uninformed and systematically correct their overreaction.

In further accordance with the article, the authors found significant differences of overreaction level between the period when the market is open and when the market is close (after-hours market). They concluded that normal-hours triggers experienced greater returns than after-hours extreme price movements.

3. Data and Methodology

3.1. Data

The sample is composed by daily open and close prices of all three types of equity and fixed income ETF exchanged on New York Stock Exchange (NYSE) and NASDAQ Stock Market between January 1st, 2007 and December 31st, 2014. The data was obtained from Bloomberg database.

For equity ETF market, we obtain a total of 848 instruments divided by international, broad-based and sector ETF, while for fixed income market our sample is composed by 87 instruments distributed by international and broad-based ETF. During the analysis period, there is no fixed income sector ETF traded on both stock markets approached. As already mentioned, equity ETF market is more developed than fixed income ETF market during the analysed period which justify the differences in the number of instruments between both markets.

The panel A of table 1 presents the composition of our sample of equity ETF. It shows that international ETF is the less represented type with almost 28% of total instruments. In respect to fixed income market, our sample is composed by more than 80% of broad-based ETF. Additionally, about 70% of our sample is composed by sovereign fixed income ETF while 30% of them is focuses on corporate debt, as shown on panel B.

Table 1 Composition of the ETF sample

Panel A. Equity ETF Sample		
Number of EQ ETF	**847**	(100%)
Sector	329	(38.8%)
Broad-Based	285	(33.7%)
International	233	(27.5%)
Panel B. Fixed Income Sample		
Number of FI ETF	87	(100%)
Broad-Based	70	(80.5%)
International	17	(19.5%)
Corporate	26	(29.9%)
Sovereign	61	(70.1%)

3.2. Methodology

The methodology followed in this dissertation is similar in most respects to the one used by Madura and Richie (2010). We also apply the same methodology on ETF fixed income market. Therefore, we distinguish a day (24 hours) in two different periods: 1) normal-hours period which correspond to market open hours; 2) after-hours period that corresponds to the period when market is close. As pointed out in the previous chapter, these periods show different characteristics which may be translate in different trading behaviour. Thus, an ETF with a normal-hours extreme price movement may experience a reversal in the following after-hours period and, in the same line, an after-hours extreme price movement may experience a reversal in the following normal-hours period.

Normal-hours intraday return for period (t) is computed as following:

$$R_t = \ln\left(\frac{Closing\ price_t}{Opening\ Price_t}\right) \qquad (3.1)$$

Accordingly, after-hours intraday return for period (t) is given by the following expression:

$$R_t = \ln\left(\frac{Opening\ price_{t+1}}{Closing\ Price_t}\right) \qquad (3.2)$$

For equity market, normal-hours period has delivered lower returns than after-hours period, nonetheless they are more volatile as observed by the higher standard deviation in returns. The descriptive analysis could be found on panel A of table 2. In respect to fixed income market, panel B shows that after-hours period has delivered higher returns than normal-hours period. It also shows more volatile returns, as evidence by the higher standard deviation.

Table 2 - Descriptive analysis ETF returns

Panel A. Equity ETF returns

Return	Normal-hours Period	After-hours Period
Mean	-0.04%	0.05%
Standard Error	1.72%	1.49%
Skewness	-1.17	-2.27
Minimum	-124.06%	-204.69%
Maximum	71.11%	113.94%
90th Percentile	1.36%	1.27%
10th Percentile	-1.56%	-1.23%

Panel B. Fixed Income ETF returns

Return	Normal-hours Period	After-hours Period
Mean	-0.02%	0.02%
Standard Error	0.62%	1.01%
Skewness	-3.32	-152.86
Minimum	-69.16%	-297.57%
Maximum	61.90%	69.31%
90th Percentile	0.42%	0.45%
10th Percentile	-0.47%	-0.40%

Following Madura and Richie (2010), we consider as extreme intraday price movements (trigger) all movements which vary at least 5%. Owing their characteristics, ETF tend to experience lower volatility.

The distribution of extreme price fluctuations on equity and fixed income ETF market are presented on the following tables 3 and 4, respectively. Regarding equity market, we obtain more than 36.000 extreme price fluctuations, with more than 50% of them occurring during normal-hours period. Between ETF types, we can find greater extreme price movements in broad-based ETF, while international ETF represents only about 15% of total observations. For fixed income market, we obtain 582 extreme price movements. Also here, more than 50% occurs during normal-hours period.

Table 3 - Distribution of equity ETF sample that satisfies the 5% trigger

	Winners				Losers				Total	
	Normal-hours		After-hours		Normal-hours		After-hours			
International ETF	1774	20%	2308	26%	2458	28%	2259	26%	8799	100%
Broad-Based ETF	3565	31%	1904	17%	4165	36%	1787	16%	11421	100%
Sector ETF	4750	30%	2809	18%	5884	37%	2399	15%	15842	100%
Entire Sample	10089	28%	7021	19%	12507	35%	6445	18%	36062	100%

	Total Normal-hours		Total After-hours		Total Winners		Total Losers	
International ETF	4232	19%	4567	34%	4082	24%	4717	25%
Broad-Based ETF	7730	34%	3691	27%	5469	32%	5952	31%
Sector ETF	10634	47%	5208	39%	7559	44%	8283	44%
Entire Sample	22596	100%	13466	100%	17110	100%	18952	100%

Table 4 - Distribution of fixed income ETF sample that satisfies the 5% trigger

	Winners				Losers				Total	
	Normal-hours		After-hours		Normal-hours		After-hours			
International ETF	33	19%	48	28%	69	40%	24	14%	174	100%
Broad-Based ETF	92	23%	82	20%	165	40%	69	17%	408	100%
Entire Sample	125	21%	130	22%	234	40%	93	16%	582	100%

	Total Normal-hours		Total After-hours		Total Winners		Total Losers	
International ETF	102	28%	72	32%	81	32%	93	28%
Broad-Based ETF	257	72%	151	68%	174	68%	234	72%
Entire Sample	359	100%	223	100%	255	100%	327	100%

An eventual correction to extreme fluctuations is analysed during the following two periods. Therefore, an eventual correction of normal-hours extreme price movement is analysed during the following after-hours period and the next normal-hours period.

Regarding abnormal returns resulting from extreme price fluctuation we apply the mean adjusted return model developed by Brown and Warner (1980). According to this model, the expected return is given by a constant K, which is unique for each security (i) in a specific period:

$$E(R_{it})=K_{i}. \qquad (3.3)$$

The expected return for a security in the extreme price movement day (t) is calculated as a mean of return of a period (T) that begin 255-days and finish 15 days before triggers' period (t). The formula of expected return for each security (i) is described bellow:

$$\widehat{K_{i,t}} = \frac{1}{N+1}\Sigma_{T=t-255}^{T}(R_{i,t}) \qquad (3.4)$$

The abnormal return of security (i) for a specific period ($A_{i,t}$) is given by:

$$A_{i,t} = (R_{it} - \widehat{K_{it}}) \qquad (3.5)$$

The test statistic for abnormal return is computed following a student's t-distribution.

Furthermore, we test a multivariate model for both markets. Based on our literature review, overreaction is conditional to several variables. Madura and Richie (2010) studied the impact on overreaction of several variables: ETF type, size of trigger, period of the day of extreme price movement, volume traded on trigger day and volatility over the past 90 days before trigger. Unlike Madura and Richie (2010), in our model, we do not consider the absolute values of volatility and volume occurred during event-study, but rather the abnormal values of volume and volatility. For that, we apply the same methodology used for abnormal returns, already pointed out in this chapter. The use of abnormal volatility and volume allow us to understand the impact of abnormal movements of volatility and volume on degree of overreaction.

Additionally, we include other variables such as year of the abnormal return, market sentiment (see appendix I) and tax effect on price.

For equity market, we apply the following multivariate model:

$$\begin{aligned}\mathrm{AR_i} = {} & \beta_0 + \beta_1\mathrm{AFTERHOURS_i} + \beta_2\mathrm{LOSDUM_i} + \beta_3\mathrm{TRIGGER_i} + \beta_4\mathrm{INTLDUM_i} + \\ & \beta_5\mathrm{SECTDUM_i} + \beta_6\mathrm{ABN\_VOLATILITY_i} + \beta_7\mathrm{ABN\_VOLUME_i} + \beta_8\mathrm{BULLDUM_i} + \\ & \beta_9\mathrm{TAXDUM_i} + \beta_{10}\,\mathrm{Year08} + \beta_{11}\,\mathrm{Year09} + \beta_{12}\,\mathrm{Year10} + \beta_{13}\,\mathrm{Year11} + \\ & \beta_{14}\,\mathrm{Year12} + \beta_{15}\,\mathrm{Year13} + \beta_{16}\,\mathrm{Year14} + \varepsilon_i \qquad (3.6)\end{aligned}$$

Where, dependent variable, AR, represents the abnormal return on the following period after trigger occurs, AFTERHOURS is a dummy variable which assumes value of 1 on after-hours extreme price movement and 0 otherwise. Dummy variable LOSDUM is equal to 1 in case of negative extreme price movement and 0 otherwise. TRIGGER variable measures the extreme price movement experienced by instrument while INTLDUM is a dummy variable that equals to 1 in case of international ETF and 0 otherwise. Along the same line, SECTDUM is a dummy where 1 represents a sector ETF and 0 otherwise.

ABN_VOLATILITY is the abnormal standard deviation of returns observed over the past 90 days before extreme price movement occurs. ABN_VOLUME presents the abnormal volume of shares trading during a trigger day. BULLDUM is another dummy variable that assumes value of 1 if it is a bull market period trigger and 0 otherwise. Finally, TAXDUM measures the tax effect and assumes value of 1 if abnormal returns occur during December or January months and 0 otherwise.

In order to run the model for each individual type of ETF we have to adapt the model through the exclusion of ETF type dummies, namely INTLDUM and SECTDUM.

For fixed income market, we include another dummy variable, CORPDUM which equals 1 if the ETF is exposed to corporate bonds and 0 otherwise. Corporate ETF may represent different sensibility since corporate and sovereign represents different risk profiles and characteristics (Elton *at al*.,1999). In this case, we do not include SECTDUM variable since there is no sector ETF on fixed income market. The model is expressed following:

$$AR_j = \beta_0 + \beta_1 AFTERHOURS_i + \beta_2 LOSDUM_i + \beta_3 TRIGGER_i + \beta_4 INTLDUM_i + \beta_5 CORPDUM_i + \beta_6 ABN\_VOLATILITY_i + \beta_7 ABN\_VOLUME_i + \beta_8 BULLDUM_i + \beta_9 TAXDUM_i + \beta_{10} Year08 + \beta_{11} Year09 + \beta_{12} Year10 + \beta_{13} Year11 + \beta_{14} Year12 + \beta_{15} Year13 + \beta_{16} Year14 + \varepsilon_i \quad (3.7)$$

Like equity market model, we adjust fixed income multivariate model for testing the sensibility of abnormal return by ETF type, dropping the INTLDUM dummy variable. Also, in equity and fixed income cases, we adapt multivariate models in order to isolate the abnormal returns occurred during normal-hours and after-hours periods. We also distinguish between losers (negative extreme movement price) and winners (positive extreme movement price).

Both models presented above are testing according the ordinary least squares model (OLS) since it is the most appropriate model for our sample (see appendix II). They are also testing for heteroscedasticity and corrected using White's test (1980).

In a complementary basis to our analysis, we divide our period analysis into financial crisis and recovery periods. For that, we use the periods defined by Madura *et al* (2009). According to the mentioned authors, financial crisis began at October 9th, 2007 and finished at March 9th, 2009. The recovery period is defined from that date until December 31st, 2014.

Afterwards, as an extension of this analysis, we divide our sample period according market sentiment: bull and bear market periods. For that, we apply the methodology defined by Pagan and Sossounov (2003) (see appendix I). During these market periods, the investor attitude towards risk tends to be different resulting in different behaviours according to market sentiment. Through this analysis, we intend to analyse the impact of market sentiment on ETF market returns.

4. Results

In this chapter, we present the results for equity and fixed income ETF markets. Firstly, in each sub-chapter is presented the results of abnormal returns estimation for two periods following an extreme price movement using the entire sample period (2007-2014) and the results obtained from the multivariate analysis. Afterwards, we present the results of the estimation for financial crisis and recovery periods as well as the estimation for bull and bear market periods.

4.1. Overreaction on ETF Equity Market

4.1.1. Overreaction during normal-hours and after-hours period

The table 5 shows the results for the estimation of abnormal returns when extreme price movements (trigger) occur during normal-hours period. In this case, we consider all sample period since 2007 until 2014. The second column of the table shows the mean abnormal return resulting from extreme price movements. The third and fourth columns represent the mean abnormal return occurred in the two following periods. Stress that, in this case, period 1 corresponds to the following after-hours period and period 2 corresponds the next normal-hours period. The mean abnormal return of these two periods could be found on the fifth column. The t-statistics and levels of significance appear in parentheses. The proportions of the overreaction reversed in the following period and in the following 24 hours period are shown on the sixth and seventh column, respectively. Stress that a positive number means that on subsequent period there is an extension of extreme abnormal return instead of a correction. Additionally, we consider three different minimum levels of triggers, namely, 5%, 6% and 7%, in order to observe returns behaviour as more restrictive our sample became.

Table 5 - Full sample abnormal returns following normal-hours equity triggers

	Normal-hours Period 0	After-hours Period 1	Normal-hours Period 2	24 Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 hours Period
Panel A. Winners						
Trigger=>5%	7.67%	0.28%	-0.60%	-0.32%	3.70%	-4.17%
(N = 10089)	(95.82)***	(7.34)***	(-3.28)***	(-6.36)***		
	100%;0%	*50%:50%*	*47%:53%*			
Trigger=>6%	8.91%	0.33%	-0.84%	-0.51%	3.72%	-5.75%
(N = 6212)	(75.94)***	(6.47)***	(-3.04)***	(-18.14)***		
	100%;0%	*50%:50%*	*46%:54%*			
Trigger=>7%	10.10%	0.33%	-1.07%	-0.74%	3.28%	-7.31%
(N = 4049)	(61.57)***	(5.41)***	(-2.66)***	(11.52)***		
	100%;0%	*49%:51%*	*44%:56%*			
Panel B. Losers						
Trigger<=-5%	-7.47%	-0.03%	0.66%	0.63%	0.46%	-8.44%
(N = 12507)	(-95.20)***	(3.94)***	(13.25)***	(8.58)***		
	0%;100%	*52%:48%*	*58%:42%*			
Trigger<=-6%	-8.70%	-0.11%	0.77%	0.65%	1.29%	-7.50%
(N = 8057)	(-75.91)***	(3.28)***	(11.37)***	(-2.44)**		
	0%;100%	*51%:49%*	*59%:41%*			
Trigger<=-7%	-9.93%	-0.19%	0.86%	0.67%	1.90%	-6.78%
(N = 5391)	(-61.82)***	(2.78)***	(9.76)***	(28.25)***		
	0%;100%	*50%:50%*	*59%:41%*			

Proportion of positive observations: proportion of negative observations shown in italics.

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

As shown on Panel A of table 5, about 50% of extreme positive price fluctuations (winners) experience negative return on the following after-hours period, regardless the trigger considers. In period 2, this proportion increase slightly. However, we do not observe mean reversion on period 1. Only period 2 shows significant negative abnormal return. The proportion reverted after 24 hours of trigger occurs varies between 4.17% and 7.13% as we consider a trigger of 5% and 7%, respectively.

Like winners, about 50% of negative extreme price variations (losers) experience positive abnormal returns on the following period. Also, in this case, period 1 do not show mean reversion. The size of such reversal following 24 hours varies between 8.44% and

6.78% as the trigger increase. Thus, a lower degree of overreaction is observed as the extreme abnormal return increases.

The results for extreme abnormal returns estimation during after-hours period show a different behaviour than observed previously on normal-hours estimation. The results are shown on table 6. Stress that, in this case, period 1 corresponds to the next normal-hours and the following after-hours period correspond to period 2.

Table 6 - Full sample abnormal returns following after-hours equity triggers

	After-hours **Period 0**	**Normal-hours** **Period 1**	**After-hours** **Period 2**	**24 Hours** **(Period1-2)**	**Proportion of the Overreaction Reversed in the Following Period**	**Proportion of the Overreaction Reversed in the Following 24 Hours Period**
Panel A. Winners						
Trigger=>5%	7.50%	-1.73%	-0.07%	-1.80%	-23.09%	-24.02%
(N = 7021)	(78.20)***	(-14.00)***	(2.60)***	(-23.60)***		
	100%;0%	*43%:57%*	*46%:54%*			
Trigger=>6%	8.75%	-2.46%	-0.05%	-2.50%	-28.05%	-28.60%
(N = 4388)	(62.76)***	(-13.53)***	(2.86)***	(-38.23)***		
	100%;0%	*39%:61%*	*46%:54%*			
Trigger=>7%	9.97%	-3.38%	-0.01%	-3.38%	-33.86%	-33.92%
(N = 2888)	(51.38)***	(-13.44)***	(2.92)***	(-10.77)***		
	100%;0%	*35%:65%*	*46%:54%*			
Panel B. Losers						
Trigger<=-5%	-7.53%	1.41%	0.44%	1.85%	-18.80%	-24.64%
(N = 6445)	(-68.89)***	(16.70)***	(7.36)***	(20.64)***		
	0%;100%	*31%:69%*	*28%:72%*			
Trigger<=-6%	-8.94%	1.94%	0.52%	2.46%	-21.72%	-27.53%
(N = 3827)	(-53.81)***	(15.31)***	(6.27)***	(17.80)***		
	0%;100%	*62%:38%*	*54%:46%*			
Trigger<=-7%	-10.32%	2.67%	0.56%	3.23%	-25.85%	-31.26%
(N = 2437)	(-43.33)***	(14.62)***	(5.21)***	(37.18)***		
	0%;100%	*65%:35%*	*54%:46%*			

Proportion of positive observations: proportion of negative observations shown in italics.

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

The results show that after positive triggers, on average, returns revert about 23% on the following period, with more than 57% of total extreme positive price movements experience negative abnormal returns, considering a trigger of 5%. The size of mean reversal increases as the trigger increases: 28.05% and 33.86% considering a trigger of 6% and 7%, respectively.

Losers show a small difference in the proportion reverted following extreme abnormal returns with 59% of that experiencing positive abnormal return for a trigger of 5%. Considering the same trigger, following 24 hours we observe a significant mean abnormal return of 1.85% and significance at the 1% level. The proportion of overreaction reversed in the following 24 hours varies from 24.02% to 33.92% as the minimum trigger increases. Unlike normal-hours, the level of overreaction increases with the size of extreme abnormal returns.

Overall, we observe significant differences on responses to extreme price movements between normal-hours and after-hours periods. While normal-hours extreme price movements do not experience, on average, any reversion on period 1, after-hours extreme abnormal returns show, for the same period, a significant mean reversion of 23.09% for winners and 18.80% for losers, considering a trigger of 5%. Therefore, the differences on responses following extreme abnormal returns are presented on the table 7.

Table 7 - Test of differences in equity mean abnormal returns

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	0.28%	-1.73%	2.01%	(23.42)***
6% winner	0.33%	-2.46%	2.79%	(22.15)***
7% winner	0.33%	-3.38%	3.71%	(20.96)***
5% loser	-0.03%	1.41%	-1.45%	(-10.71)***
6% loser	-0.11%	1.94%	-2.05%	(-10.07)***
7% loser	-0.19%	2.67%	-2.86%	(-10.03)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

For three levels of triggers considered, we find significant differences at the 1% level. The greater level of triggers used, higher mean differences between two periods is founded.

4.1.2. Overreaction of different ETF Types

Once the results may differ by ETF type, in this sub-chapter we present the estimation of extreme abnormal returns for each type. In this analysis is only considering the trigger of 5%.

As shown on table 8, during normal-hours period the results for broad-based and sector winners show no mean reversion on Period 1 while international ETF experience a slight reversion. This type also experiences the greatest size of reversal following 24 hours for both winners and losers while broad-based ETF shows the lowest degree of overreaction. This result is in line with our expectations since broad-based ETF presents the highest level of diversification so may be less sensitive to deviations from its fundamental value.

Table 8 - Abnormal returns following equity triggers by ETF types

	Period 0	Period 1	Period 2	(Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A – Normal-hours						
Winners						
International ETF	7.44%	-0.07%	-0.59%	-0.66%	-0.98%	-8.87%
(N = 1774)	(39.00)***	(-0.46)	(-6.21)***	(-4.77)***		
	100%;0%	*46%:54%*	*47%:53%*			
Broad Based ETF	7.53%	0.41%	-0.58%	-0.17%	5.47%	-2.20%
(N = 3565)	(55.95)***	(5.01)***	(-8.69)***	(-2.42)**		
	100%;0%	*50%:50%*	*49%:51%*			
Sector ETF	7.87%	0.32%	-0.63%	-0.31%	4.07%	-3.93%
(N = 4750)	(67.35)***	(4.54)***	(-10.77)***	(-4.25)***		
	100%;0%	*51%:49%*	*46%:54%*			
Losers						
International ETF	-7.21%	0.23%	0.54%	0.77%	-3.18%	-10.65%
(N = 2458)	(-40.67)***	(2.39)**	(4.23)***	(4.81)***		
	0%;100%	*54%:46%*	*59%:41%*			
Broad Based ETF	-7.51%	-0.30%	0.68%	0.39%	3.96%	-5.13%
(N = 4165)	(-55.29)***	(-3.55)***	(7.43)***	(2.62)***		
	0%;100%	*51%:49%*	*58%:42%*			
Sector ETF	-7.55%	0.04%	0.70%	0.75%	-0.56%	-9.88%
(N = 5884)	(-66.00)***	(0.89)	(9.15)***	(7.19)***		
	0%;100%	*52%:48%*	*57%:43%*			
Panel B – After-hours						
Winners						
International ETF	7.34%	-0.91%	-0.27%	-1.18%	-12.41%	-16.11%
(N = 2308)	(43.92)***	(-8.41)***	(-3.96)***	(-9.15)***		
	100%;0%	*48%:52%*	*45%:55%*			
Broad Based ETF	7.53%	-1.76%	-0.07%	-1.83%	-23.35%	-24.33%
(N = 1904)	(40.91)***	(-14.88)***	(-1.81)*	(-12.50)***		
	100%;0%	*43%:57%*	*45%:55%*			
Sector ETF	7.60%	-2.39%	0.10%	-2.29%	-31.39%	-30.08%
(N = 2809)	(50.14)***	(-24.59)***	(-0.30)	(-18.73)***		
	100%;0%	*39%:61%*	*47%:53%*			
Losers						
International ETF	-7.32%	0.76%	0.48%	1.24%	-10.34%	-16.96%
(N = 2259)	(-39.61)***	(7.20)***	(3.52)***	(7.93)***		
	0%;100%	*56%:44%*	*58%:42%*			
Broad Based ETF	-7.49%	1.49%	0.41%	1.90%	-19.91%	-25.36%
(N = 1787)	(-36.08)***	(12.48)***	(2.46)**	(11.15)***		
	0%;100%	*60%:40%*	*53%:47%*			
Sector ETF	-7.75%	1.98%	0.42%	2.40%	-25.52%	-30.94%
(N = 2399)	(-43.33)***	(19.13)***	(2.97)***	(16.52)***		
	0%;100%	*63%:37%*	*53%:47%*			

Proportion of positive observations: proportion of negative observations shown in italics.

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

On panel B is shown the estimation for after-hours extreme prices movements. In this case, sector ETF experiences higher mean reversion on period 1 following a trigger. On the other hand, international ETF shows the lowest size of overreaction between the three types. Owing their characteristics, the process to incorporate relevant information is different from the other types. Differences of mean reversals after extreme price movements by types of ETF are summarized on table 9.

Table 9 - Test of differences in equity mean abnormal returns between ETF types

Panel A. Summary of Abnormal return by Type following a 5% trigger			
	International ETF	**Sector ETF**	**Broad-Based ETF**
Normal-hours Winners	-0.07%	0.32%	0.41%
Normal-hours Losers	0.23%	0.04%	-0.30%
After-hours Winners	-0.91%	-2.39%	-1.76%
After-hours Losers	0.76%	1.98%	1.49%
Panel B. Differences of Abnormal Return			
	AR intl - AR sector	**AR intl - AR broad**	**AR sector - AR broad**
Normal-hours Winners	-0.55%	-0.58%	-0.03%
	(-3.41)***	(-4.01)***	(-1.04)
Normal-hours Losers	0.23%	0.52%	0.28%
	(1.06)	(3.09)***	(1.80)*
After-hours Winners	1.71%	0.54%	-0.89%
	(10.37)***	(3.17)***	(-6.18)***
After-hours Losers	-1.31%	-0.45%	0.92%
	(-8.56)***	(-3.24)***	(5.09)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Major differences are observed between international and sector ETF during after-hours periods, following by the difference between sector and broad-based ETF. Regarding normal-hours periods, international and broad-based ETF experience the greatest difference. All these differences are significant at the 1% level.

4.1.3. Multivariate analysis

In this sub-chapter is presented the results from multivariate model in order to assess the sensibility of reversals following an extreme price movement to different explanatory variables. This analysis is divided by winners and losers' observations as well as normal-hours and after-hours triggers. The results are presented on table 10.

Table 10 - Multivariate equity market model ETF[1]

	Overall Model	Normal-hours	After-hours	Winners	Losers
AFTERHOURS	-0.002***			-0.021***	0.016***
	(0.000)			(0.000)	(0.000)
LOSDUM	-0.022***	0.000	-0.038***		
	(0.000)	(0.940)	(0.009)		
TRIGGER	-0.213***	0.022*	-0.458***	-0.377***	-0.112***
	(0.000)	(0.064)	(0.000)	(0.000)	(0.001)
INTLDUM	0.001	0.001	0.001	0.002	0.000
	(0.247)	(0.212)	(0.680)	(0.136)	(0.986)
SECTDUM	0.000	0.001**	-0.001	-0.001*	0.003***
	(0.644)	(0.017)	(0.447)	(0.088)	(0.000)
BULLDUM	0.001	-0.002*	0.003*	-0.001	0.001
	(0.410)	(0.069)	(0.083)	(0.383)	(0.289)
TAXDUM	0.003***	0.001*	0.003*	-0.009***	0.014***
	(0.000)	(0.063)	(0.097)	(0.000)	(0.000)
ABN_VOLUME	0.000	0.000	0.000	-0.000	0.000**
	(0.770)	(0.817)	(0.186)	(0.443)	(0.022)
ABN_VOLATILITY	-0.005	0.021	-0.005	0.002	-0.169***
	(0.356)	(0.298)	(0.304)	(0.395)	(0.000)
Year08	0.000	-0.005***	0.011**	0.011***	-0.008***
	(0.760)	(0.123)	(0.277)	(0.000)	(0.000)
Year09	-0.000	-0.003**	0.008	0.006***	-0.007***
	(0.987)	(0.001)	(0.038)	(0.000)	(0.007)
Year10	0.001	-0.003**	0.011**	0.011***	-0.011***
	(0.893)	(0.047)	(0.133)	(0.003)	(0.009)
Year11	0.001	-0.004**	0.009*	0.016***	-0.015***
	(0.770)	(0.038)	(0.049)	(0.000)	(0.000)
Year12	0.001	-0.003	0.009*	0.012***	-0.013***
	(0.619)	(0.025)	(0.087)	(0.000)	(0.000)
Year13	0.001	-0.002	0.008	0.008***	-0.009***
	(0.660)	(0.133)	(0.093)	(0.000)	(0.000)
Year14	-0.001	-0.003	0.006	0.014***	-0.017***
	(0.566)	(0.312)	(0.158)	(0.003)	(0.007)
Constant	0.010***	0.004**	0.007	0.023***	-0.002
	(0.002)	(0.015)	(0.480)	(0.000)	(0.445)
Observations	36,062	22,596	13,466	17,110	18,952
Adj r-squared	0.034	0.002	0.141	0.102	0.042
F	25.34	4.666	62.33	54.35	42.57
Prob>F	0.00	0.00	0.00	0.00	0.00

[1]The dependent variable is the abnormal return following extreme price movements. Dummy variable AFTERHOURS equals one if the trigger occurs on after-hours period and zero otherwise. LOSDUM assumes one, in case of losers triggers and zero otherwise. TRIGGER variable measure the extreme price fluctuations observed. The variable ABN_VOLUME corresponds to the abnormal volume traded on trigger day measured by the difference between volume on trigger day and the mean of volume traded over the last 255 days ending 15 prior the trigger. Based on the same methodology is computed ABN_VOLATILITY variable which refers to the abnormal standard deviation of returns observed over the past ninety days before trigger. The dummy variable BULLDUM assumes value of one if extreme price movement occurs during a bull market period and zero otherwise. TAXDUM takes the value of one if trigger occurs during December or January months and 0 otherwise. YEAR09 assumes value of one if the trigger occurs during 2009 and zero otherwise. The same is true for dummies variables: YEAR10, YEAR11, YEAR12, YEAR13 and YEAR14. See chapter 3 for details. Robust pval in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% levels, respectively.

Normal-hours model shows a coefficient for TRIGGER of 0.022 meaning that only 2.2% of abnormal return on the period 1 is explained by extreme price movements, *ceteris paribus,* with significance at the 10% level. A positive coefficient suggests that higher extreme price movements tend to present lower levels of overreaction which corroborates our previous estimations.

The after-hours model shows a TRIGGER coefficient of -0.458 indicating that 45.8% of the abnormal return on period 1 is preceded by the extreme price movement, *ceteris paribus*. Moreover, a negative LOSDUM dummy on after-hours model and significant at the 1% level indicates a more pronounced correction on the following period in case of winners, with other factors constants.

On the other hand, winners and losers' models show that after-hours extreme price movements suffer a less favourable mean reversion than normal-hours extreme price movements. In both models, AFTERHOURS dummy variable is significant at the 1% level. Also, both models show a significant TAXDUM dummy variable at the 1% level, suggesting that the level of overreaction is less favourable during December and January months, with other factors constants. In case of winners model, a TRIGGER coefficient variable equals to -0.377 suggests that 37.7% of abnormal return on the following period is explained by winners extreme price movements, *ceteris paribus,* while losers model reports a coefficient for such variable equals to -0.115.

It is also important to emphasize that all models are significant at the 1% level. However, normal-hours model shows a reduce predictability power. It could suggest that this market presents a higher level of efficiency during normal-hours periods. Thus, we are not able to predict the abnormal return. Nonetheless, it could also means that the behaviour of noise traders have a randomly impact on the market, so abnormal returns that arise from their activity affect all ETF market being not possible to predict by analysing to different variables.

Afterwards, we analyse a multivariate model for each ETF type and the results are presented on table 11.

Table 11 - Multivariate equity market model by ETF Type[2]

	Panel A - International ETF				Panel B- Sector ETF				Panel C- Broad-Based ETF			
	Normal-hours	**After-hours**	**Winners**	**Losers**	**Normal-hours**	**After-hours**	**Winners**	**Losers**	**Normal-hours**	**After-hours**	**Winners**	**Losers**
AFTERHOURS			-0.008***	0.006***			-0.027***	0.020***			-0.022***	0.019***
			(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)
LOSDUM	0.009**	-0.067***			-0.003	-0.008			0.001	-0.063***		
	(0.019)	(0.000)			(0.202)	(0.675)			(0.750)	(0.000)		
TRIGGER	0.042	-0.567***	-0.414***	-0.197**	-0.004	-0.339**	-0.371***	-0.072	0.053***	-0.632***	-0.399***	-0.160***
	(0.122)	(0.000)	(0.000)	(0.023)	(0.843)	(0.012)	(0.000)	(0.106)	(0.004)	(0.000)	(0.000)	(0.000)
BULLDUM	-0.003	0.002	-0.004	0.005*	-0.002	0.009**	0.000	0.002	-0.001	0.001	-0.002	0.000
	(0.255)	(0.425)	(0.177)	(0.067)	(0.235)	(0.014)	(0.870)	(0.448)	(0.407)	(0.752)	(0.305)	(0.984)
TAXDUM	0.001	0.007***	-0.012***	0.016***	0.001	0.004	-0.008***	0.013***	0.002**	-0.001	-0.013***	0.017***
	(0.519)	(0.001)	(0.000)	(0.000)	(0.522)	(0.165)	(0.000)	(0.000)	(0.043)	(0.865)	(0.000)	(0.000)
ABN_VOLUME	0.000	0.000	0.000*	0.000	-0.000	0.000*	0.000	0.000	-0.000	-0.000	-0.000***	0.000
	(0.335)	(0.210)	(0.071)	(0.151)	(0.805)	(0.068)	(0.106)	(0.703)	(0.544)	(0.197)	(0.004)	(0.186)
ABN_VOLATILITY	0.007	-0.187*	0.264***	-0.287***	0.024	-0.003	-0.001	-0.085**	0.030	-0.468***	0.191***	-0.270***
	(0.930)	(0.072)	(0.002)	(0.001)	(0.386)	(0.253)	(0.450)	(0.034)	(0.368)	(0.000)	(0.000)	(0.000)
Year08	-0.008***	0.006	0.003	-0.007	-0.009***	0.020**	0.011***	-0.006	0.002	0.001	0.011***	-0.012**
	(0.421)	(0.967)	(0.050)	(0.001)	(0.003)	(0.736)	(0.005)	(0.000)	(0.563)	(0.609)	(0.000)	(0.012)
Year09	-0.005*	-0.003	-0.006	-0.007	-0.007***	0.021***	0.008**	-0.004	0.003	-0.007	0.008**	-0.012**
	(0.009)	(0.444)	(0.579)	(0.160)	(0.000)	(0.011)	(0.001)	(0.103)	(0.599)	(0.935)	(0.000)	(0.031)
Year10	-0.006*	0.001	0.011*	-0.017***	-0.007***	0.024***	0.007**	-0.003	0.002	-0.008	0.011***	-0.015***
	(0.083)	(0.745)	(0.338)	(0.136)	(0.000)	(0.008)	(0.015)	(0.313)	(0.358)	(0.331)	(0.017)	(0.021)
Year11	-0.005	0.003	0.012*	-0.017***	-0.009***	0.017**	0.013***	-0.013***	0.004	-0.003	0.017***	-0.017***
	(0.071)	(0.874)	(0.070)	(0.001)	(0.001)	(0.003)	(0.028)	(0.400)	(0.535)	(0.279)	(0.001)	(0.009)
Year12	-0.006	-0.001	0.010	-0.020***	-0.006**	0.017*	0.008**	-0.005	0.002	-0.007	0.019***	-0.020***
	(0.132)	(0.739)	(0.051)	(0.001)	(0.000)	(0.031)	(0.000)	(0.001)	(0.283)	(0.665)	(0.000)	(0.004)
Year13	-0.003	0.002	0.010	-0.016***	-0.006***	0.007	0.003	-0.005	0.003	0.005	0.004	-0.002
	(0.211)	(0.921)	(0.121)	(0.000)	(0.011)	(0.056)	(0.030)	(0.342)	(0.585)	(0.322)	(0.000)	(0.006)
Year14	-0.005	-0.000	0.013**	-0.020***	-0.007***	0.003	0.011***	-0.016***	0.002	-0.004	0.015***	-0.017**
	(0.453)	(0.820)	(0.106)	(0.004)	(0.009)	(0.440)	(0.460)	(0.219)	(0.432)	(0.607)	(0.328)	(0.787)
Constant	0.003	0.030***	0.025***	-0.003	0.011***	-0.019	0.023***	-0.001	-0.002	0.037***	0.023***	-0.002
	(0.372)	(0.002)	(0.002)	(0.662)	(0.000)	(0.183)	(0.000)	(0.820)	(0.458)	(0.000)	(0.000)	(0.658)
Observations	4,232	4,567	4,082	4,717	10,634	5,208	7,559	8,283	7,730	3,691	5,469	5,952
Adj r-squared	0.0001	0.1298	0.0738	0.0347	0.0016	0.1388	0.1125	0.0444	0.0115	0.2061	0.1257	0.0575
F	1.596	14.47	10.18	11.29	3.571	42.97	35.74	22.18	6.753	30.01	26.31	20.64
Prob>F	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[2]The dependent variable is the abnormal return following extreme price movements. Dummy variable AFTERHOURS equals one if the trigger occurs on after-hours period and zero otherwise. LOSDUM assumes one,in case of losers triggers and zero otherwise. TRIGGER variable measure the extreme price fluctuations observed. The variable ABN_VOLUME corresponds to the abnormal volume traded on trigger day measured by the difference between volume on trigger day and the mean of volume traded over the last 255 days ending 15 prior the trigger. Based on the same methodology is computed ABN_VOLATILITY variable which refers to the abnormal standard deviation of returns observed over the past ninety days before trigger. The dummy variable BULLDUM assumes value of one if extreme price movement occurs during a bull market period and zero otherwise. TAXDUM takes the value of one if trigger occurs during December or January months and 0 otherwise. YEAR09 assumes value of one if the trigger occurs during 2009 and zero otherwise. The same is true for dummies variables: YEAR10, YEAR11, YEAR12, YEAR13 and YEAR14. See chapter 3 for details. Robust pval in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% levels, respectively.

For normal-hours international ETF model, LOSDUM is positive and significant at the 5% level suggesting that the responses to normal-hours extreme abnormal returns are more pronounced in case of winners than for losers triggers, with other factors constants. On after-hours model, a TRIGGER coefficient equals to -0.567 indicates that after-hours extreme price movements of international ETF explain about 56.7% of abnormal return on the following period, *ceteris paribus.* It is significant at the 1% level. Winners and losers models show sensibility of dependent variable to abnormal volatility with significance at the 1% level which suggest that the level of abnormal volatility influence the level of overreaction experience by this type of ETF, with other factors constants. TAXDUM variable is also significant at the 1% level in both models.

Regarding sector ETF, after-hours model shows a TRIGGER coefficient equals to -0.339, at the 5% level of significance. Also, BULLDUM dummy variable is positive and significant at the 5% level which indicates that overreaction following an extreme after-hours trigger is less favourable during bull market than during bear market periods, with other factor constants. Losers model shows a positive and significant AFTERHOURS dummy variable suggesting higher degree of correction tend to occur following after-hours triggers, with other factors constants. The same conclusion is achieved in case of winners model. This result corroborates previous estimation results.

In case of broad-based ETF, a TRIGGER coefficient equals to -0.632 on after-hours model suggests that more than 63% of extreme abnormal return during after-hours period is reverted during the following period, *ceteris paribus*, at the 1% level of significance. Normal-hours model shows a TRIGGER variable equals to 0.053, at the 1% level of significance. Like international ETF, also broad-based ETF winners and losers models show significance at ABN_VOLATILITY variable, at the 1% level of significance.

Overall, we conclude different behaviours between normal-hours and after-hours periods. It could be observed on our estimations results and, also, in our multivariate models. Our results show that the degree of overreaction is greater on after-hours periods for both winners and losers and for the three types of ETF.

Furthermore, our estimation for normal-hours period shows no mean reversal during period 1 following extreme price movements. Additionally, winners after-hours triggers show greater level of overreaction following extreme abnormal return than in case of losers.

The analysis by ETF types allows us to conclude that international ETF show the greatest size of reversion among all three types following normal-hours triggers, while during after-hours period they show the lowest degree of overreaction. This may be justified by the composition of the underlying, foreign assets, so the news are not available and incorporate at the same time as the other types.

Through the multivariable models analysis, we conclude a significant sensibility to the sign and magnitude of extreme price movement and to tax effects. It also shows greater sensibility to such explanatory variables on after-hours and winners models.

4.1.4. Overreaction and Financial Crisis

The financial crisis of 2007/2008 was the most important event in the last decade for financial markets, putting in evidence the credit risk presented on the market. Consequently, investors started to look for low credit risk instruments in order to mitigate their potential losses. As previous mentioned this event has a turning point for ETF market, owing its characteristics such as diversification and low transaction costs.

In this sub-chapter, we aim to understand ETF returns behaviour during and after such unique event. For that, we define the financial period and, subsequently recovery based on Madura *et al* (2009). According to them, financial crisis lasted from October 9th, 2007 until March 9th, 2009 and the recovery period began at March 9th, 2009 until December 31st, 2014.

Overall, 99% of our full extreme abnormal returns sample occurred during these two periods, where more than 60% occurred during financial crisis period. A more detail distribution of winners and losers across normal-hours and after-hours periods divided by financial crisis and recovery periods could be found on annex III.

a) Overreaction on financial crisis period

Following the same line as full sample period analysis, firstly we present the abnormal return estimation results for normal-hours and after-hours periods. Afterwards, we estimate the degree of overreaction by ETF type. In this case, both estimations consider a trigger level equals to 5%.

The results for the full sample estimation of overreaction after an extreme price movement could be found on Table 12.

Table 12 - Abnormal returns following equity triggers during financial crisis period

	Period 0	Period 1	Period 2	24 Hours (Period 1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A. Normal-hours						
Winners						
Trigger=>5%	8.00%	0.42%	-0.65%	-0.23%	5.20%	-2.92%
(N = 6058)	(74.29)***	(6.02)***	(-11.10)***	(-3.31)***		
	100%;0%	*50%:50%*	*48%:52%*			
Losers						
Trigger<=-5%	-7.80%	-0.16%	0.56%	0.40%	2.09%	-5.08%
(N = 7874)	(-72.61)***	(-2.12)**	(7.42)***	(3.66)***		
	0%;100%	*50%:50%*	*58%:42%*			
Panel B. After-hours						
Winners						
Trigger=>5%	7.91%	-2.48%	0.10%	-2.38%	-31.35%	-30.08%
(N = 3940)	(59.26)***	(-26.95)***	(-0.14)	(-2.67)***		
	100%;0%	*39%:61%*	*48%:52%*			
Losers						
Trigger<=-5%	-7.87%	2.15%	0.42%	2.57%	-27.33%	-32.69%
(N = 3706)	(-50.25)***	(23.18)***	(3.52)***	(2.51)**		
	0%;100%	*66%:34%*	*51%:49%*			

Proportion of positive observations: proportion of negative observations shown in italics.

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Normal-hours extreme price fluctuations do not experience mean reversion on period 1 in cases of winners and losers. In total of two periods following trigger we observe a slightly mean reversion equals to 2.92% in case of winners and equals to 5.08% in case of losers. Both values are significant at the 1% level.

In the same line that full sample estimation, after-hours abnormal returns experience greater degree of overreaction than normal-hours triggers. Both winners and losers experience a significant mean reversion on the period following the extreme abnormal return. Following 24 hours period after trigger occurs, the size of reversal is more than 30% for both winners and losers. The differences between normal-hours and after-hours mean reversals are reflected on table 13.

Table 13 - Test of differences in equity mean abnormal return during financial crisis period

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	0.42%	-2.48%	2.90%	(-0.25)
5% loser	-0.16%	2.15%	-2.31%	(-37.76)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

On losers side, the difference of mean abnormal return on period 1 is equal to -2.31% and significant at the 1% level. For winners, the difference is equal to 2.90% however it is not statistically significant.

Regarding ETF types, the abnormal return estimation results show greater significant abnormal returns following after-hours triggers for all three types, with international ETF experiencing the lowest mean reversal. It is true for winners and losers. While following normal-hours trigger, international ETF are the only type that shows a slight reversal on period 1. A summary of abnormal returns after a trigger and the differences between the three types are shown on table 14.

Table 14 - Test of differences in equity mean abnormal returns between ETF types during financial crisis period

Panel A. Summary of Abnormal return by Type following a 5% trigger			
	International ETF	**Sector ETF**	**Broad-Based ETF**
Normal-hours Winners	-0.08%	0.44%	0.62%
Normal-hours Losers	0.18%	-0.09%	-0.45%
After-hours Winners	-1.23%	-3.08%	-2.85%
After-hours Losers	1.40%	2.42%	2.57%

Panel B. Differences of Abnormal Return			
	AR intl - AR sector	**AR intl - AR broad**	**AR sector - AR broad**
Normal-hours Winners	-1.05%	-1.14%	-0.13%
	(-3.14)***	(-3.30)***	(-1.09)
Normal-hours Losers	0.23%	0.40%	0.28%
	(1.23)	(2.02)**	(0.98)
After-hours Winners	1.35%	1.19%	-0.09%
	(4.76)***	(4.36)***	(-0.58)
After-hours Losers	-1.32%	-1.20%	0.24%
	(-4.69)***	(-3.51)***	(0.49)

. *, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

The differences of mean abnormal return following a trigger between ETF types show that for normal-hours periods, international and broad-based ETF experience higher differences with significance at the 1% level in case of winners, and at the 5% level in case of losers. On the other hand, the highest difference during after-hours period is experienced by international and sector ETF with significance at the 1% level.

A more detail description and results for financial crisis abnormal return estimation by ETF type is presented on annex III.

b) Overreaction on recovery period

Regarding recovery period estimation, the results for full sample estimation are presented on table 15.

Table 15 - Abnormal returns following equity triggers during recovery period

	Period 0	Period 1	Period 2	24 Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A. Normal-hours						
Winners						
Trigger=>5%	7.17%	0.07%	-0.54%	-0.47%	0.93%	-6.58%
(N = 3952)	(54.13)***	(1.03)	(-7.67)***	(-4.66)***		
	100%;0%	*51%:49%*	*47%:53%*			
Losers						
Trigger<=-5%	-6.90%	0.20%	0.84%	1.05%	-2.96%	-15.18%
(N = 4567)	(-48.47)***	(2.73)***	(9.24)***	(8.62)***		
	0%;100%	*55%:45%*	*57%:43%*			
Panel B. After-hours						
Winners						
Trigger=>5%	6.96%	-0.74%	-0.30%	-1.04%	-10.62%	-14.89%
(N = 3040)	(46.18)***	(-6.88)***	(-4.23)***	(-8.22)***		
	100%;0%	*49%:51%*	*42%:58%*			
Losers						
Trigger<=-5%	-7.03%	0.35%	0.46%	0.82%	-5.03%	-11.59%
(N = 2710)	(-38.09)***	(3.46)***	(3.40)***	(5.04)***		
	0%;100%	*51%:49%*	*59%:41%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

As shown on table 15, normal-hours extreme price movements experience greater level of overreaction than financial crisis period regardless the sign of movement. Unlike financial crisis period, we observe a slightly correction on period 1 for losers with significance at the 5% level, while in case of winners we continue to observe no mean reversion on period 1.

After-hours extreme abnormal returns show a lower level of mean reversion during recovery period than during financial crisis. The size of reversion on the following period is equal to 10.62% for winners and 5.03% for losers.

Unlike financial crisis period, the differences of mean reversals following normal-hours and after-hours extreme price movements are reduced as shown on table 16.

Table 16 - Test of differences in equity mean abnormal returns during recovery period

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	0.07%	-0.74%	0.81%	(-0.15)
5% loser	0.20%	0.35%	-0.15%	(-8.73)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance

From the analysis by types of ETF we can conclude, like in financial crisis period, only international ETF winners experience negative mean abnormal return after normal-hours periods extreme price fluctuations, as presented on table 17.

Table 17 - Test of differences in equity mean abnormal returns between ETF types during recovery period

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	Sector ETF	Broad-Based ETF
Normal-hours Winners	-0.07%	0.13%	0.04%
Normal-hours Losers	0.30%	0.27%	0.04%
After-hours Winners	-0.60%	-1.37%	0.04%
After-hours Losers	0.06%	1.23%	-0.34%

Panel B. Differences of Abnormal Return

	AR intl - AR sector	AR intl - AR broad	AR sector - AR broad
Normal-hours Winners	-0.51%	-0.13%	0.12%
	(-0.74)	(0.19)	(-1.70)*
Normal-hours Losers	-0.69%	-0.23%	0.86%
	(-1.57)	(-0.19)	(2.31)**
After-hours Winners	0.70%	-1.13%	-1.50%
	(4.39)***	(-4.52)***	(-6.91)***
After-hours Losers	-0.96%	0.82%	2.00%
	(-2.62)***	(3.66)***	(5.64)***

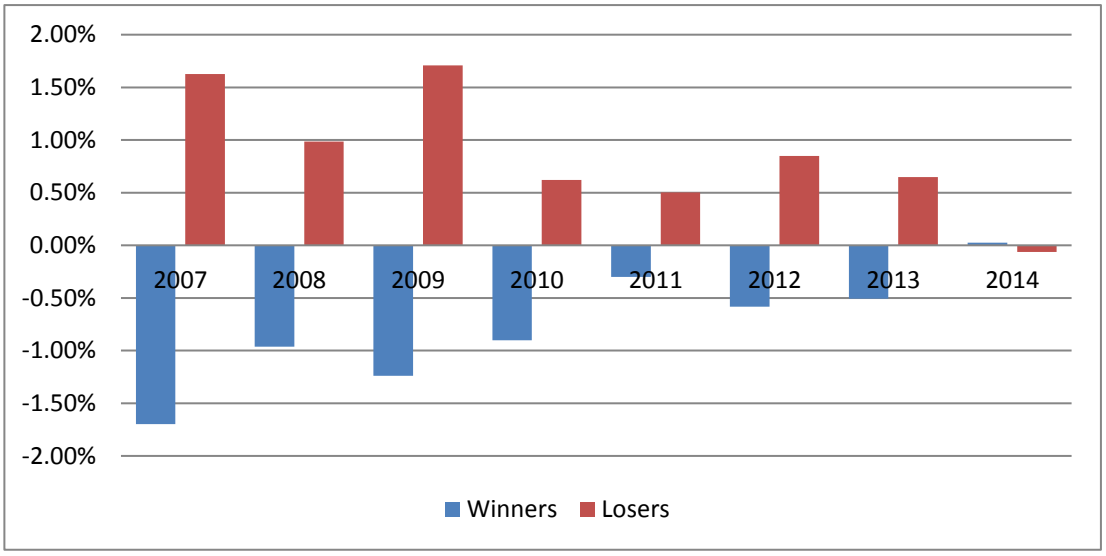
*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

During after-hours period, sector ETF shows higher degree of overreaction than others, which is in line with our expectations since it is characterized by low diversification level among all three types.

During normal-hours period we only observe significant differences between sector and broad-based ETF regardless the movement sign. These two ETF types also show the greatest difference on after-hours triggers with significance at the 1% level. Overall, differences between the three types of ETF are higher during after-hours periods. More detail results of abnormal returns estimation during recovery period by ETF type could be found in annex III.

From the overreaction analysis during and after financial crisis periods, we can conclude some relevant differences between both periods. The figure 1 presents the mean reversals following two periods after triggers occur by years where it is possible to observe greater degree of overreaction during financial crisis years, corroborating our previous results.

Figure 1 - Equity mean reversion in the 2 periods following extreme price movements by years



During financial crisis period there is a clear difference between normal-hours and after-hours extreme price movements. Normal-hours extreme abnormal returns results show a slight mean reversion only on period 2 while after-hours triggers present a more pronounce response with a size of mean reversion of more than 30% following 24 hours of triggers occur, for both winners and losers. During recovery period, the differences between normal-hours and after-hours triggers are low. Comparing to financial crisis period, normal-hours triggers show higher degree of overreaction while after-hours extreme price movements experience a lower degree of overreaction.

Table 18 presents the differences between financial crisis and recovery period. On that is possible to observe higher differences in case of after-hours triggers. The difference between after-hours losers is significance at the 1% level.

Table 18 - Test of differences of equity mean reversions between financial crisis and recovery period

	Normal-hours	**After-hours**
Winners	0.35%	-1.74%
	(-0.36)	(0.58)
Losers	-0.37%	1.80%
	(1.18)	(-2.72)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

4.1.5. Overreaction and market sentiment

In this sub-chapter is presented the results for abnormal returns estimation during bull and bear market periods. These periods may present different investors risk appetites, while investors during bull market periods tend to be more optimistic about the market evolution and, consequently they tend to assume a *risk on* position, during bear market periods investors tend to be more pessimist assuming lower risk positions. For this estimation is only considered a trigger of 5%.

Dividing our sample between bull and bear market periods we obtain a much larger sample on bear market periods, about 93%. It may suggest that bear market periods are more favourable to extreme price movements. A more complete description of our sample distinguished between bull and bear periods could be found on annex I.

a) Overreaction on bull market periods

The results for bull market period are shown on table 19.

Table 19 - Abnormal returns following equity triggers during bull market periods

	Period 0	Period 1	Period 2	24 Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A. Normal-hours						
Winners						
Trigger=>5%	6.73%	0.01%	-0.39%	-0.38%	0.22%	-5.61%
(N = 1253)	(34.87)***	(-0.67)	(-4.85)***	(-4.04)***		
	100%;0%	*51%:49%*	*45%:55%*			
Losers						
Trigger<=-5%	-6.51%	0.23%	0.49%	0.55%	-3.48%	-8.52%
(N = 1405)	(-32.51)***	(1.73)*	(5.17)***	(3.71)***		
	0%;100%	*53%:47%*	*56%:44%*			
Panel B. After-hours						
Winners						
Trigger=>5%	6.72%	-0.33%	-0.18%	-0.52%	-4.98%	-7.71%
(N = 1085)	(32.42)***	(-4.15)***	(-2.37)**	(-4.82)***		
	100%;0%	*53%:47%*	*45%:55%*			
Losers						
Trigger<=-5%	-7.06%	0.54%	0.20%	0.74%	-7.68%	-10.54%
(N = 1148)	(-31.98)***	(4.84)***	(1.65)*	(4.82)***		
	0%;100%	*51%:49%*	*56%:44%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance

Regarding normal-hours extreme abnormal returns we observe that the degree of overreaction on the following two periods is similar to our full sample analysis results, with winners reverting, on average, 5.61% of extreme mean abnormal return experienced and losers reverting 8.52%, both with significance at the 1% level.

The results for after-hours extreme abnormal returns estimation could be consulted on panel B. In this case, winners present a significant mean reversion equals to 5% on the period 1 and 7.71% combined the two following periods. Losers show a slightly higher level of proportion reverted with, on average, 7.68% on the following period and 10.54% on the two following periods. Differences between mean abnormal return following normal-hours and after-hours triggers are small and not statistically significant in both cases winners and losers. The results are shown on table 20.

Table 20 - Test of differences in equity mean abnormal returns during bull market periods

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	0.01%	-0.33%	0.35%	(-0.25)
5% loser	0.23%	0.54%	-0.32%	(1.39)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Regarding ETF types, a summary of mean abnormal returns on period 1 and mean differences between the three ETF types are reported on table 21.

Table 21 - Test of differences in equity mean abnormal returns between different ETF types during bull market periods

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	Sector ETF	Broad-Based ETF
Normal-hours Winners	-0.35%	0.17%	0.03%
Normal-hours Losers	0.25%	0.08%	-0.12%
After-hours Winners	0.06%	-0.92%	-0.43%
After-hours Losers	0.14%	1.21%	0.68%

Panel B. Differences of Abnormal Return

	AR intl - AR sector	AR intl - AR broad	AR sector - AR broad
Normal-hours Winners	-1.33%	-0.44%	0.45%
	(-3.34)***	(-1.24)	(1.14)
Normal-hours Losers	0.53%	0.04%	-0.22%
	(1.80)*	(0.07)	(-1.16)
After-hours Winners	1.08%	0.65%	-0.36%
	(3.22)***	(1.70)*	(-1.41)
After-hours Losers	-0.83%	-0.16%	0.58%
	(-2.09)**	(-0.48)	(1.35)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

As full sample analysis, international ETF presents the greatest degree of overreaction during normal-hours period, with significance at the 1% level. Also in case of after-hours extreme price movements, sector ETF experience the highest level of overreaction, while international experience the lowest level.

The differences between ETF types are shown on panel B. In this case we observe significant differences between international and sector ETF regardless the sign and the period of extreme price movement. Also, after-hours winners show a significant difference between international and broad-based ETF. As already pointed out, the incorporation of relevant information on international ETF price may be delayed due differences of time zones, with investors taking advantages of that. On the other hand, sector ETF are the lowest diversified type, thus more susceptible to mispricing. A more detail estimation of abnormal return by ETF type could be found on annex II.

b) Overreaction on bear market periods

In respect to bear market periods, for normal-hours extreme price movements the results, which are presented on table 22, are similar to bull market periods. The size of mean reversals is about 4% and 8.43% for winners and losers, respectively, following 24 hours the trigger.

Table 22 - Abnormal returns following equity triggers during bear market periods

	Period 0	Period 1	Period 2	24 Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A. Normal-hours						
Winners						
Trigger=>5%	7.81%	0.32%	-0.63%	-0.31%	4.12%	-3.99%
(N = 8836)	(89.31)***	(6.21)***	(-14.39)***	(-5.56)***		
	100%;0%	*50%:50%*	*48%:52%*			
Losers						
Trigger<=-5%	-7.59%	-0.05%	0.69%	0.64%	0.62%	-8.43%
(N = 11102)	(-89.29)***	(-0.31)	(11.44)***	(7.91)***		
	0%;100%	*52%:48%*	*58%:42%*			
Panel B. After-hours						
Winners						
Trigger=>5%	7.64%	-1.99%	-0.05%	-2.04%	-26.00%	-26.64%
(N = 5936)	(71.71)***	(-28.21)***	(-2.87)***	(-23.29)***		
	100%;0%	*18%:82%*	*20%:80%*			
Losers						
Trigger<=-5%	-7.63%	1.60%	0.49%	2.09%	-21.03%	-27.46%
(N = 5297)	(-61.99)***	(22.29)***	(5.07)***	(20.40)***		
	0%;100%	*61%:39%*	*54%:46%*			

Proportion of positive observations : proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

However, results from after-hours extreme price movements show that 82% winners experience significant extreme negative abnormal return on period 1, while 61% of losers show significant positive abnormal returns on the following period. Unlike bull market periods, the size of mean reversal after the two periods is more than 26% for both losers and winners.

The following table 23 reports the differences between normal-hours and after-hours mean abnormal return on period 1.

Table 23 - Test of differences in equity mean abnormal returns during bear market periods

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	0.32%	-1.99%	2.31%	(-1.23)
5% loser	-0.05%	1.60%	-1.65%	(-65.37)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Unlike bull market periods, on bear market periods we obtain significant mean difference equals to -1.65% in case of losers. For winners, the mean difference is 2.31%, however it is not statistically significant.

A summary of estimation results by ETF type are shown on table 24.

Table 24 - Test of differences in equity mean abnormal returns between ETF types during bear market periods

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	Sector ETF	Broad-Based ETF
Normal-hours Winners	-0.02%	0.34%	0.46%
Normal-hours Losers	0.22%	0.04%	-0.32%
After-hours Winners	-1.19%	-2.57%	-1.97%
After-hours Losers	0.97%	2.08%	1.64%

Panel B. Differences of Abnormal Return

	AR intl - AR sector	AR intl - AR broad	AR sector - AR broad
Normal-hours Winners	-0.77%	-0.93%	-0.11%
	(-2.20)**	(-3.17)***	(-1.35)
Normal-hours Losers	-0.10%	0.16%	0.43%
	(0.51)	(1.49)	(2.00)**
After-hours Winners	1.14%	0.38%	-0.65%
	(5.81)***	(2.32)**	(-3.31)***
After-hours Losers	-1.29%	-0.37%	0.85%
	(-5.03)***	(-0.91)	(3.58)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

In this case, we achieve the same conclusions that bull market periods, with international ETF experiencing the greatest degree of overreaction during normal-hours periods. In case of after-hours extreme price movements, sector ETF experience the highest proportion of

reversal 24 hours after triggers occur. Nevertheless, and in line with previous conclusions, bear market periods show a more pronounced degree of overreaction in all three ETF type regardless the time and the sign of trigger. The only exception is broad-based normal-hours triggers which present a slightly lower mean reversal on bear market periods. The differences of abnormal return between the three type show significant differences between all types, being more pronounced between international and sector ETF after-hours triggers. A more detail results of estimation by ETF type could be found on annex I.

Overall, the analysis between bear and bull market periods suggests a more pronounced degree of overreaction during bear market periods, mainly following after-hours extreme abnormal returns. Additionally, unlike bear market periods, we do not find significant mean abnormal returns differences between normal-hours and after-hours triggers during bull market period.

By ETF type, we conclude that in both periods the greatest mean difference occurs between international ETF and sector ETF. Nevertheless, during bull market period we do not find significant differences with other types, while during bear market periods there are significant abnormal returns differences following extreme price movements in almost all periods and between the three ETF types. Regarding the abnormal returns differences between both periods we observe higher differences during after-hours periods in both winners and losers. These differences are significant at the 1% level, as reported on table 25.

Table 25 - Test of differences in equity mean reversions between bull and bear market periods

	Normal-hours	**After-hours**
Winners	-0.31%	1.65%
	(-0.77)	(3.97)***
Losers	0.27%	-1.06%
	(1.63)	(6.42)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

4.2 Overreaction on ETF Fixed Income Market

4.2.1. Overreaction during normal-hours and after-hours period

As already mentioned, ETF fixed income market is a recent market which have been faced a huge development over the last decade. This study focuses on US market, the most developed and liquid ETF market. Yet, this market is not as developed as ETF equity market, so there is a limited range of instruments available during the analysis period.

As far as we know there are no other studies approaching overreaction on ETF fixed income market, so this study intends to be a first contribute for this theme.

Like in equity market analysis, we divide our sample in sub-periods, namely, financial crisis and recovery periods as well as bull and bear market periods. The present analysis focuses on international and broad-based ETF types, since there are no sector fixed income ETF during the analysis period.

Firstly, the table 26 presents the estimation results for abnormal returns following normal-hours extreme price fluctuations.

Table 26 - Full sample abnormal returns following normal-hours fixed income triggers

	Normal-hours Period 0	After-hours Period 1	Normal-hours Period 2	24Hours (Period1 -2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A. Winners						
Trigger=>5%	7.65%	0.70%	-0.48%	0.23%	9.19%	2.96%
(N = 125)	(12.02)***	(1.70)*	(-1.48)	(0.30)		
	100%:0%	*51%:49%*	*48%:52%*			
Trigger=>6%	8.88%	0.92%	-0.68%	0.24%	10.31%	2.70%
(N = 78)	(10.88)***	(1.76)*	(-1.61)	(0.25)		
	100%:0%	*53%:47%*	*47%:53%*			
Trigger=>7%	9.85%	1.23%	-0.74%	0.49%	12.50%	4.94%
(N = 53)	(9.86)***	(1.95)*	(-1.45)	(0.50)		
	100%:0%	*60%:40%*	*45%:55%*			
Panel B. Losers						
Trigger<=-5%	-7.40%	0.46%	0.25%	0.71%	-6.24%	-9.59%
(N = 234)	(-12.75)***	(1.52)	(0.73)	(1.61)		
	0%:100%	*59%:41%*	*53%:47%*			
Trigger<=-6%	-8.55%	0.49%	0.32%	0.82%	-5.78%	-9.55%
(N = 155)	(-12.19)***	(1.33)	(0.82)	(1.53)		
	0%:100%	*63%:37%*	*54%:46%*			
Trigger<=-7%	-9.68%	0.44%	0.63%	1.07%	-4.55%	-11.07%
(N = 104)	(-11.46)***	(0.97)	(1.46)	(1.68)*		
	0%:100%	*63%:37%*	*55%:45%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Through the results presented we conclude that winners, on average, do not experience any correction in the following two periods. For a 5% trigger, 51% of winners experience abnormal positive returns on period 1 while 60% of losers experience positive abnormal return on the same period. Notwithstanding, in case of losers, we observe a small size of reversals equals to 6.24%, 5.78% and 4.55% for a trigger of 5%, 6% and 7%, respectively.

Like equity market, also fixed income market after-hours triggers present a very different behaviour from normal-hours extreme price movements. The results for after-hours extreme price movements are shown on table 27.

Table 27 - Full sample abnormal returns following after-hours fixed income triggers

	After-hours Period 0	Normal-hours Period 1	After-hours Period 2	24 Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A. Winners						
Trigger=>5%	7.34%	-2.44%	0.09%	-2.35%	-33.28%	-32.04%
(N = 130)	(11.81)***	(-6.11)***	(0.10)	(-4.49)***		
	100%:0%	*32%:68%*	*50%:50%*			
Trigger=>6%	8.32%	-3.05%	-0.08%	-3.12%	-36.63%	-37.57%
(N = 88)	(10.89)***	(-6.27)***	(-0.31)	(-4.88)***		
	100%:0%	*27%:73%*	*47%:53%*			
Trigger=>7%	9.26%	-3.57%	0.25%	-3.31%	-38.49%	-35.78%
(N = 59)	(9.84)***	(-6.01)***	(0.37)	(-4.23)***		
	100%:0%	*25%:75%*	*47%:53%*			
Panel B. Losers						
Trigger<=-5%	-7.11%	1.35%	0.25%	1.60%	-19.00%	-22.47%
(N = 93)	(-7.68)***	(2.84)***	(0.45)	(2.41)**		
	0%:100%	*58%:42%*	*58%:42%*			
Trigger<=-6%	-8.50%	2.14%	0.11%	2.26%	-25.23%	-26.56%
(N = 50)	(-6.88)***	(3.31)***	(0.10)	(2.53)**		
	0%:100%	*64%:36%*	*54%:46%*			
Trigger<=-7%	-9.31%	2.14%	0.83%	2.97%	-23.00%	-31.90%
(N = 34)	(-6.28)***	(2.73)***	(1.12)	(2.77)***		
	0%:100%	*62%:38%*	*56%:44%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

The results show that, for a trigger of 5%, 68% of after-hours winners experience a negative significant abnormal return on period 1 with a mean abnormal return equals to -2.44% and significance at the 1% level. For a trigger of 7%, we conclude a mean abnormal return equals to -3.75% and significance at the 1% level with 75% of winners experiencing negative abnormal return on period 1. Unlike normal-hours period, the size of mean reversions increases with the trigger consider and it is equal to 33.28%, 36.63% and 38.49% for a 5%, 6% and 7% trigger, respectively. Also in case of losers, the level of overreaction is greater than during normal-hours periods. Notwithstanding, it is slightly lower than observed for winners. For a trigger of 5%, the proportion of overreaction reversed in the following period

is about 19%, while for a trigger of 6% and 7%, it is equals to 25.23% and 23%, respectively. Stress that all these results are significant at the 1% level. The differences between normal-hours and after-hours mean abnormal return on period 1 are presented on table 28.

Table 28 -Test of differences in fixed income mean abnormal returns

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	0.70%	-2.44%	3.14%	(6.22)***
6% winner	0.92%	-3.05%	3.96%	(5.61)***
7% winner	1.23%	-3.57%	4.80%	(5.13)***
5% loser	0.46%	1.35%	-0.89%	(1.88)*
6% loser	0.49%	2.14%	-1.65%	(1.57)
7% loser	0.44%	2.14%	-1.70%	(1.47)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Overall, the greatest difference is observed among winners cases, with a mean difference equals to 3.14%, 3.96% and 4.80% for a trigger of 5%, 6% and 7%, respectively. These differences are significant at the 1% level. In respect to losers, we observe smaller differences and only in case of 5% trigger we observe statistically significance at the 10% level. In this case, the difference between mean abnormal returns is equal to -0.89%.

4.2.2. Overreaction in different ETF Types

Regarding our analysis by ETF types, the results are presented on table 29. Stress that, for this analysis, we consider only 5% trigger.

Table 29 - Abnormal returns following fixed income triggers by ETF types

	Period 0	Period 1	Period 2	24 Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A - Normal Hours						
Winners						
International ETF	8.27%	1.03%	-0.93%	0.10%	12.45%	1.15%
(N = 33)	(6.63)***	(1.29)	(-1.42)	(0.03)		
	100%:0%	*55%:45%*	*45%:55%*			
Broad Based ETF	7.42%	0.58%	-0.31%	0.27%	7.88%	3.68%
(N = 92)	(10.04)***	(1.21)	(-0.88)	(0.33)		
	100%:0%	*50%:50%*	*49%:51%*			
Losers						
International ETF	-7.75%	0.85%	0.66%	1.51%	-10.96%	-19.52%
(N = 69)	(-7.30)***	(1.53)	(1.25)	(1.96)**		
	0%;100%	*64%:36%*	*61%:39%*			
Broad Based ETF	-7.25%	0.30%	0.07%	0.37%	-4.13%	-5.15%
(N = 165)	(-10.46)***	(0.82)	(0.05)	(0.65)		
	0%;100%	*58%:42%*	*50%:50%*			
Panel B - After Hours						
Winners						
International ETF	7.96%	-3.45%	-0.15%	-3.60%	-43.30%	-45.23%
(N = 48)	(7.73)***	(-5.24)***	(-0.36)	(-4.14)***		
	100%:0%	*25%:75%*	*52%:48%*			
Broad Based ETF	6.97%	-1.85%	0.23%	-1.62%	-26.57%	-23.22%
(N = 82)	(8.96)***	(-3.69)***	(0.40)	(-2.48)**		
	100%:0%	*35%:65%*	*49%:51%*			
Losers						
International ETF	-7.58%	1.84%	0.45%	2.29%	-24.30%	-30.19%
(N = 24)	(-4.20)***	(1.97)**	(0.47)	(1.78)*		
	0%;100%	*75%:25%*	*71%:29%*			
Broad Based ETF	-6.94%	1.18%	0.18%	1.36%	-16.99%	-19.53%
(N = 69)	(-6.44)***	(2.13)**	(0.25)	(1.75)*		
	0%;100%	*52%:48%*	*54%:46%*			

Proportion of positive observations : proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

The results show that regardless the period of the day that trigger occurs, international ETF experience higher degree of overreaction than broad-based ETF. However, it is important to notice that the low number of observations for international ETF could influence the results

obtained. Additionally, none of types experience a mean reversion following a normal-hours winner trigger.

The differences of mean abnormal returns on period 1 between both types could be found on table 30. It allows us to conclude that only normal-hours losers mean difference is significant at the 10% level. Notwithstanding, the greatest difference are observed between after-hours extreme price movements.

Table 30 -Test of differences in fixed income mean abnormal returns between different ETF types

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	**Broad-Based ETF**
Normal-hours Winners	1.03%	0.58%
Normal-hours Losers	0.85%	0.30%
After-hours Winners	-3.45%	-1.85%
After-hours Losers	1.84%	1.18%

Panel B. Differences of Abnormal Return

	AR intl - AR Broad-Based
Normal-hours Winners	0.45%
	(0.69)
Normal-hours Losers	0.55%
	(1.73)*
After-hours Winners	-1.60%
	(-1.11)
After-hours Losers	0.66%
	(0.74)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

4.2.3 The multivariate analysis

The results from multivariate model applied for fixed income market are shown on table 31. As we did for equity market, also in this case we run a multivariate model for normal-hours and after-hours observations as well as for winners and losers triggers.

Table 31 - Multivariate model for fixed income ETF[3]

	Overall Model	Normal-hours	After-hours	Winner	Loser
AFTERHOURS	-0.010**			-0.030***	0.009*
	(0.028)			(0.000)	(0.093)
LOSDUM	-0.004	0.009	-0.044		
	(0.729)	(0.396)	(0.107)		
TRIGGER	-0.123	0.082	-0.566***	-0.356**	-0.047
	(0.176)	(0.258)	(0.003)	(0.039)	(0.507)
INTLDUM	-0.003	0.004	-0.008	-0.009	0.006
	(0.555)	(0.485)	(0.314)	(0.300)	(0.220)
CORPDUM	0.006	0.005	0.013	0.020**	0.000
	(0.185)	(0.295)	(0.149)	(0.017)	(0.941)
BULLDUM	-0.009	-0.004	-0.015	-0.014	0.000
	(0.107)	(0.552)	(0.149)	(0.215)	(0.985)
TAXDUM	-0.008*	-0.007	-0.011	-0.022***	-0.004
	(0.087)	(0.210)	(0.207)	(0.004)	(0.550)
ABN_VOLUME	-0.000	-0.000*	-0.001**	-0.000	-0.000
	(0.438)	(0.089)	(0.045)	(0.399)	(0.114)
ABN_VOLATILITY	0.272	0.117	0.850	1.079**	-0.245
	(0.342)	(0.686)	(0.112)	(0.031)	(0.443)
Year08	-0.016	-0.013	0.001	-0.043***	-0.009
	(0.118)	(0.169)	(0.953)	(0.004)	(0.451)
Year09	-0.024**	-0.017**	-0.011	-0.055***	-0.014
	(0.012)	(0.042)	(0.433)	(0.000)	(0.169)
Year10	-0.027**	-0.021**	-0.011	-0.068***	-0.011
	(0.016)	(0.031)	(0.403)	(0.000)	(0.323)
Year11	-0.019*	-0.020**	0.000	-0.040***	-0.022**
	(0.057)	(0.040)	(0.982)	(0.006)	(0.042)
Year12	-0.011	-0.011	0.010	-0.030**	-0.010
	(0.290)	(0.279)	(0.375)	(0.041)	(0.357)
Year13	-0.019*	-0.018		-0.032	-0.023*
	(0.092)	(0.113)		(0.103)	(0.085)
Year14	-0.008	-0.021**	0.044*	-0.038**	0.004
	(0.583)	(0.030)	(0.056)	(0.019)	(0.802)
Constant	0.027**	0.016	0.021	0.076***	0.014
	(0.044)	(0.183)	(0.248)	(0.004)	(0.305)
Observations	582	359	223	255	327
Adj r-squared	0.062	0.004	0.221	0.184	-0.001
F	3.356	1.369	6.549	22.13	1.123
Prob>F	0.00	0.16	0.00	0.00	0.33

[3]The dependent variable is the abnormal return following extreme price movements. Dummy variable AFTERHOURS equals one if the trigger occurs on after-hours period and zero otherwise. LOSDUM assumes one on losers observations and zero otherwise. TRIGGER variable measure the extreme price fluctuations observed. INTLDUM assumes value of one in case of international ETF and zero otherwise while CORPDUM is one if ETF are composed by corporate bonds and zero otherwise. The variable ABN_VOLUME corresponds to the abnormal volume traded on trigger day measured by the difference between volume on trigger day and the mean of volume traded over the last 255 days ending 15 prior the trigger. Based on the same methodology is computed ABN_VOLATILITY variable which refers to the abnormal standard deviation of returns observed over the past ninety days before trigger. The dummy variable BULLDUM assumes value of one if extreme price movement occurs during a bull market period and zero otherwise. TAXDUM takes the value of one if trigger occurs during December or January months and 0 otherwise. YEAR09 assumes value of one if the trigger occurs during 2009 and zero otherwise. The same is true for dummies variables: YEAR10, YEAR11, YEAR12, YEAR13 and YEAR14. See chapter 3 for details.
Robust pval in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% levels, respectively.

Regarding normal-hours model, the dependent variable shows a significant sensibility to abnormal volume on the trigger day with significant at the 10% level. On the other hand, after-hours model shows significance of TRIGGER and ABN_VOLUME variables at the 1% level. In this case, the TRIGGER coefficient equals to -0.566 suggests that 56.6% of the reversal on period 1 is preceded by the extreme price movement, *ceteris paribus*.

In case of winners' model, we observe a negative AFTERHOURS dummy variable with significance at the 1% level suggesting a more pronounce response in case of after-hours winners than normal-hours winners. Additionally, 35.6% of abnormal return on period 1 is explained by the positive extreme price movement, *ceteris paribus*, with significance at the 5% level. Losers model also shows significance at AFTERHOURS dummy variable, with 10% level of significance.

Stress that normal-hours and losers multivariate models are not overall significant. It could suggest that this market presents a higher level of efficiency during normal-hours periods. Thus, we are not able to predict the abnormal return. However, it could also means that the behaviour of noise traders randomly impact on the market, so abnormal returns that arise from their activity affect all ETF market, being not possible to predict by analysing to different variables.

Then, we compute a multivariate model for each type of ETF and the results are shown on table 32.

Table 32 -Multivariate model for fixed income ETF divided by type[4]

	Panel A. International ETF				Panel B. Broad-Based ETF			
	Normal-hours	**After-hours**	**Winners**	**Losers**	**Normal-hours**	**After-hours**	**Winners**	**Losers**
AFTERHOURS			-0.040***	0.012			-0.023***	0.009
			(0.008)	(0.349)			(0.001)	(0.181)
LOSDUM	-0.003	0.010			0.015	-0.086**		
	(0.917)	(0.759)			(0.187)	(0.011)		
TRIGGER	-0.008	-0.228	-0.314	0.057	0.122*	-0.837***	-0.265	-0.087
	(0.967)	(0.291)	(0.154)	(0.696)	(0.097)	(0.001)	(0.275)	(0.298)
CORPDUM	0.004	0.028*	0.045***	-0.007	0.008	0.014	0.015	0.007
	(0.724)	(0.059)	(0.006)	(0.451)	(0.121)	(0.252)	(0.129)	(0.285)
BULLDUM	0.004	-0.008	-0.001	0.004	-0.008	-0.021*	-0.020	-0.002
	(0.780)	(0.675)	(0.956)	(0.729)	(0.253)	(0.093)	(0.133)	(0.747)
TAXDUM	-0.008	-0.012	-0.015	-0.011	-0.006	-0.013	-0.027***	0.001
	(0.323)	(0.350)	(0.152)	(0.306)	(0.414)	(0.304)	(0.005)	(0.906)
ABN_VOLUME	-0.000	-0.002***	-0.000	-0.001	-0.000	0.001	-0.000	-0.000
	(0.337)	(0.002)	(0.275)	(0.300)	(0.921)	(0.487)	(0.929)	(0.163)
ABN_VOLATILITY	0.160	1.855**	1.276*	0.280	-0.080	-0.200	0.654	-0.954**
	(0.713)	(0.031)	(0.087)	(0.612)	(0.850)	(0.810)	(0.400)	(0.033)
Year08	0.004	0.007	0.044*	0.007	-0.020	-0.052*	-0.058***	-0.013
	(0.764)	(0.774)	(0.050)	(0.616)	(0.115)	(0.069)	(0.002)	(0.391)
Year09	-0.005	-0.009	0.010	0.007	-0.021*	-0.057**	-0.052***	-0.018
	(0.709)	(0.620)	(0.621)	(0.557)	(0.058)	(0.045)	(0.001)	(0.174)
Year10	-0.003			0.005	-0.026**	-0.069**	-0.082***	-0.019
	(0.779)			(0.561)	(0.036)	(0.012)	(0.000)	(0.193)
Year11	-0.023			0.006	-0.019	-0.045*	-0.045**	-0.022
	(0.169)			(0.644)	(0.120)	(0.084)	(0.017)	(0.138)
Year12	-0.004	0.036***	0.065***	0.002	-0.012	-0.055**	-0.046***	-0.016
	(0.701)	(0.009)	(0.005)	(0.828)	(0.389)	(0.042)	(0.009)	(0.308)
Year13	-0.013	0.039	0.083***	-0.038**	-0.023	-0.063**	-0.059**	-0.024
	(0.442)	(0.118)	(0.002)	(0.012)	(0.112)	(0.030)	(0.016)	(0.154)
Year14					-0.022*		-0.051***	0.003
					(0.084)		(0.004)	(0.889)
Constant	0.007	-0.047	-0.036	0.006	0.019	0.103***	0.086**	0.017
	(0.818)	(0.104)	(0.350)	(0.641)	(0.194)	(0.006)	(0.015)	(0.327)
Observations	83	54	58	79	217	117	136	198
Adj r-squared	-0.117	0.306	0.233	-0.101	0.004	0.185	0.136	0.011
F	6.42	8.324	4.426	84.29	1.397	3.258	16.4	1.241
Prob>F	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.25

[4]The dependent variable is the abnormal return following extreme price movements. Dummy variable AFTERHOURS equals one if the trigger occurs on after-hours period and zero otherwise. LOSDUM assumes one on losers observations and zero otherwise. TRIGGER variable measure the extreme price fluctuations observed. INTLDUM assumes value of one in case of international ETF and zero otherwise while CORPDUM is one if ETF is composed by corporate bonds and zero otherwise. The variable ABN_VOLUME corresponds to the abnormal volume traded on trigger day measured by the difference between volume on trigger day and the mean of volume traded over the last 255 days ending 15 prior the trigger. Based on the same methodology is computed ABN_VOLATILITY variable which refers to the abnormal standard deviation of returns observed over the past ninety days before trigger. The dummy variable BULLDUM assumes value of one if extreme price movement occurs during a bull market period and zero otherwise. TAXDUM takes the value of one if trigger occurs during December or January months and 0 otherwise. YEAR09 assumes value of one if the trigger occurs during 2009 and zero otherwise. The same is true for dummies variables: YEAR10, YEAR11, YEAR12, YEAR13 and YEAR14. See chapter 3 for details.
Robust pval in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% levels, respectively.

Stress that in some ETF type models, dummies variables covering different years do not present any value since there are no observations for such specific year.

In case of international ETF, all models shows no significance of TRIGGER variable. The after-hours model shows sensibility of dependent variable to abnormal volume and abnormal volatility. It also shows a positive CORPDUM variable with significance at the 10% level. In case of winners' model, AFTERHOURS and CORPDUM dummy variables have a significant influence on the level of overreaction. All models for international ETF are overall significant at the 1% level.

Regarding broad-based ETF normal-hours model, it shows a significant TRIGGER coefficient equals to 0.122. In case of after-hours model, we observe a TRIGGER coefficient equals to -0.837, which suggest that 83.7% of reversal could be explained by size of extreme price movements occurred during after-hours period, *ceteris paribus*. On the other hand, winners model shows a negative significant AFTERHOURS dummy variable indicating greater degree of overreaction following an after-hours trigger. Such result corroborates the findings of previous estimation. However, for this type of ETF, normal-hours and losers models are not overall significant.

Overall, like in equity market, we conclude a lower degree of overreaction on normal-hours than after-hours triggers in ETF fixed income market. In normal-hours periods, winners do not experience mean reversion in the two period following extreme price movements. In case of losers, we conclude a size of mean reversal of about 10% for the same period. The scenario is different for after-hours extreme abnormal returns. In this case, we observe significant reversals in both winners and losers, being more pronounced on winners.

The analysis by ETF types suggests greater degree of overreaction in case of international ETF which meets our expectations since broad-based ETF have the more diversified underlying.

From multivariate models analysis, we conclude that the degree of overreaction is sensible to the magnitude of extreme movements (trigger). Moreover, the period of day when occur the extreme price movements also have a significant impact on the size of response to them, in case of winners.

4.2.4. Overreaction and Financial Crisis

In this sub-chapter, we analyse the patterns of overreaction observed on US fixed income ETF market during financial crisis. For that, as previous mentioned, we divide our analysis into financial crisis and recovery periods. Like on equity market, we use the periods defined by Madura *et al.* (2009). According to authors, financial crisis began on October 9th, 2007 ending on March 9th, 2009. The recovery period started at March 9th, 2009 until December 31st, 2014.

In this analysis was only consider a trigger of 5%. More than 99% of our full sample observations occurred during these two periods. A more detail description of our sample distributed by these two periods may be found on annex III.

a) Overreaction on financial crisis period

The results of abnormal returns estimation for financial crisis period are shown on table 33.

Table 33 - Abnormal returns following fixed income triggers during financial crisis period

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A. Normal-hours						
Winners						
Trigger=>5%	8.21%	1.55%	-1.00%	0.55%	18.91%	6.73%
(N = 64)	(9.37)***	(1.49)	(-1.48)	(-0.01)		
	100%:0%	*64%:36%*	*44%:56%*			
Losers						
Trigger<=-5%	-7.45%	0.45%	-0.04%	0.41%	-5.99%	-5.45%
(N = 133)	(-9.19)***	(-0.48)	(0.11)	(-0.25)		
	0%:100%	*59%:41%*	*50%:50%*			
Panel B. After-hours						
Winners						
Trigger=>5%	7.35%	-1.15%	0.61%	-0.54%	-15.61%	-7.33%
(N = 59)	(8.16)***	(-2.84)***	(1.09)	(-1.21)		
	100%:0%	*34%:66%*	*54%:46%*			
Losers						
Trigger<=-5%	-7.41%	2.53%	0.18%	2.71%	-34.09%	-36.50%
(N = 40)	(-5.01)***	(2.44)**	(0.34)	(1.94)*		
	0%:100%	*70%:30%*	*58%:43%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Panel A reports the results for normal-hours triggers and they show that winners do not experience a mean correction on the following period, while losers experience a slightly mean reversion of 5.99% on period 1. However, the responses to extreme abnormal returns in both cases are not statistically significant.

Unlike normal-hours, after-hours extreme price movements show significant reversals on winners and losers, being both significant at the 5% level. A more pronounced level of degree is found on negative abnormal returns.

The mean abnormal return differences between normal-hours and after-hours periods are presented on table 34.

Table 34 - Test of differences in fixed income mean abnormal returns during financial crisis period

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	1.55%	-1.15%	2.70%	(-0.01)
5% loser	0.45%	2.53%	-2.08%	(-3.51)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

We conclude significant mean abnormal return differences following normal-hours and after-hours triggers, in case of losers. This difference is equal to -2.08% with significance at the 1% level.

The analysis by ETF type allow us to conclude that normal-hours winners for both types do not experience mean correction after extreme abnormal returns, while losers show a slightly reversion on the following period. However, both types show, on average, greater level of overreaction following losers abnormal returns regardless the period of the day, as reported on table 35.

Table 35 - Test of differences in fixed income mean abnormal returns between different ETF types during financial crisis period

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	Broad-Based ETF
Normal-hours Winners	1.26%	1.72%
Normal-hours Losers	0.92%	0.19%
After-hours Winners	-1.73%	-0.75%
After-hours Losers	2.22%	2.73%

Panel B. Differences of Abnormal Return

	AR intl - AR Broad-Based
Normal-hours Winners	-0.46%
	(-0.05)
Normal-hours Losers	0.73%
	(0.97)
After-hours Winners	-0.99%
	(-0.39)
After-hours Losers	-0.51%
	(-0.07)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

On the other hand, panel B shows no significant mean abnormal return differences between international and broad-based ETF in both periods. A more detail results of this estimation could be found on annex III.

b) Overreaction on recovery period

In this sub-chapter is analysed the abnormal returns after financial crisis, known as recovery period. The results may be consulted on table 36.

Table 36 - Abnormal returns following fixed income triggers during recovery period

	Period 0	Period 1	Period 2	24Hours (Period 1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A. Normal-hours						
Winners						
Trigger=>5%	7.05%	-0.19%	0.07%	-0.12%	-2.69%	-1.64%
(N = 61)	(7.59)***	(0.89)	(-0.37)	(0.52)		
	100%:0%	*38%:62%*	*52%:48%*			
Losers						
Trigger<=-5%	-7.35%	0.48%	0.63%	1.11%	-6.50%	-15.12%
(N = 100)	(-8.76)***	(2.76)***	(1.51)	(3.10)***		
	0%:100%	*60%:40%*	*57%:43%*			
Panel B. After-hours						
Winners						
Trigger=>5%	7.32%	-3.52%	-0.34%	-3.86%	-48.01%	-52.66%
(N = 71)	(8.48)***	(-5.81)***	(-1.65)*	(-5.68)***		
	100%:0%	*30%:70%*	*46%:54%*			
Losers						
Trigger<=-5%	-6.88%	0.46%	0.30%	0.76%	-6.73%	-11.05%
(N = 53)	(-5.93)***	(1.98)**	(0.23)	(1.75)*		
	0%:100%	*49%:51%*	*58%:42%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Unlike financial crisis period, recovery period estimation shows that more than 60% of normal-hours winners experience negative abnormal return on the following period. Even so, the size of mean reversal is 2.69% and it does not show statistically significance. Losers, on the other hand, experience a mean reversion equals to 6.50% with significance at the 1% level. After-hours extreme price fluctuations show important differences comparing to financial crisis. As it is possible to observe on panel B, winners experience a significant negative mean abnormal return equals to -3.52% on period 1 which means 48.01% of the extreme mean abnormal return reverted in the following period. By contrast, the mean abnormal return experienced by losers on period 1 is equal to 0.46% which correspond to 6.73% of the extreme mean abnormal return reverted on period 1. Both reversions are significant at the 5% level.

The mean abnormal return differences following normal-hours and after-hours triggers are shown on table 37. Winners show the greatest difference however it is no statistically significant. On the other hand, the mean difference observed between normal-hours and after-hours losers is equal to 0.02% and significant at the 1% level.

Table 37 - Test of differences in fixed income mean abnormal returns during recovery period

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	-0.19%	-3.52%	3.33%	(-0.87)
5% loser	0.48%	0.46%	0.02%	(-4.62)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

The analysis by ETF type allows us to conclude that both types experience greater degree of overreaction during after-hours period. Also, during this period we observe greater differences on mean abnormal returns between both types, as presented on table 38.

Table 38 - Test of differences in fixed income mean abnormal returns between ETF types during recovery period

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	Broad-Based ETF
Normal -hours Winners	0.50%	-0.32%
Normal-hours Losers	0.69%	0.42%
After-hours Winners	-5.16%	-2.67%
After-hours Losers	0.46%	1.09%

Panel B. Differences of Abnormal Return

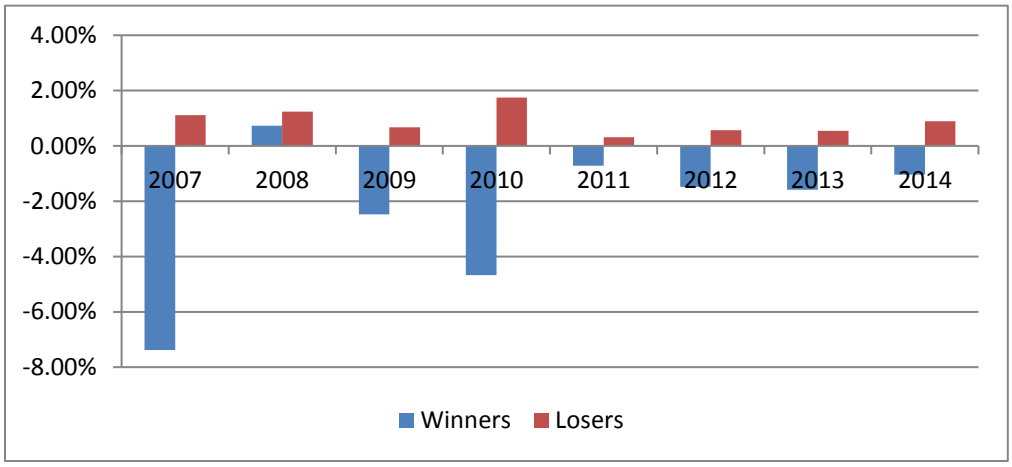
	AR intl - AR Broad-Based
Normal-hours Winners	0.82%
	(0.66)
Normal-hours Losers	0.27%
	(0.43)
After-hours Winners	-2.49%
	(-1.84)*
After-hours Losers	-0.63%
	(0.75)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

A more detail results of this estimation could be found on annex III.

Overall, we find some differences between financial crisis and recovery periods. Figure 2 presents the mean reversion on the following two periods after extreme abnormal returns occur by year. We observe greater reversions in case of winners, being more pronounced during 2010. It is important to stress that the number of observations on 2007, 2013 and 2014 are less than 10, so the numbers of such years are not representative of the market.

Figure 2 - Fixed income mean reversion in the 2 periods following extreme price movements by years



Comparing normal-hours and after-hours periods, both periods show higher degree of overreaction in case of after-hours extreme price movements. However, there are some relevant differences. While during financial crisis, winners experience a significant mean reversion equals to 15% of the extreme abnormal return on period 1, during recovery period 48% of the mean extreme positive abnormal return revert on the following period. Contrarily, losers show a more pronounce response after extreme price fluctuations during financial period.

The table 39 presents the mean reversion differences between these two periods.

Table 39 - Test of differences of fixed income mean reversions between financial crisis and recovery period

	Normal-hours	**After-hours**
Winners	1.74%	2.37%
	(-0.01)	(-0.79)
Losers	-0.03%	2.06%
	(-0.23)	(0.19)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

On that, we conclude there are no significant differences of mean reversals between financial crisis and recovery periods, Even so, after-hours responses to extreme abnormal return show greater differences than normal-hours responses. These results suggest that even

during such unique event, the degree of overreaction on the market is reduced during normal-hours, however it is more pronounced during after-hours period. Nonetheless, the differences between the two periods analysed are not clearly, while losers show a greater response on financial crisis period, winners experience higher degree of overreaction during recovery period.

As already pointed out, these results could be explained by the presence of higher proportion of uninformed investors to informed traders presented on the market during this period. Investors, in accordance with behavioural finance theories, tend to overweight recent movements of the price in detrimental of fundamental value which could explain the greater degree of overreaction on losers during financial crisis and winners during recovery period.

4.2.5. Overreaction and market sentiment

In this sub-chapter is presented the results of abnormal returns estimation during bull and bear fixed income market periods. For the same reasons presented on equity market, different market sentiment may be characterized by different investors' behaviours. The distinction between bull and bear market periods follows Pagan and Sossounov (2003) methodology which are described on appendix I. The distribution of our sample between both periods could be found on annex I. Also, for this estimation is only considers one level of trigger equals to 5%.

a) Overreaction on bull market periods

Through bull market periods analysis, we conclude that normal-hours mean abnormal returns on period 1 are in line with already discussed on the full sample period analysis, with slight reversals in case of losers. The results are shown in the following table 40.

Table 40 - Abnormal returns following fixed income triggers during bull market periods

	Period 0	Period 1	Period 2	24 Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A. Normal-hours						
Winners						
Trigger=>5%	7.42%	0.06%	-0.22%	-0.15%	0.84%	-2.06%
(N = 83)	(9.21)***	(1.19)	(-0.48)	(0.56)		
	100%:0%	*46%:54%*	*54%:46%*			
Losers						
Trigger<=-5%	-7.49%	0.38%	0.09%	0.46%	-5.03%	-6.18%
(N = 149)	(-10.50)***	(2.50)**	(0.29)	(2.09)**		
	0%:100%	*58%:42%*	*50%:50%*			
Panel B. After-hours						
Winners						
Trigger=>5%	7.33%	-3.32%	-0.11%	-3.44%	-45.34%	-46.91%
(N = 85)	(9.21)***	(-6.16)***	(-0.25)	(-4.83)***		
	100%:0%	*27%:73%*	*53%:47%*			
Losers						
Trigger<=-5%	-7.12%	0.82%	0.24%	1.06%	-11.45%	-14.86%
(N = 50)	(-5.75)***	(2.18)**	(0.44)	(1.96)**		
	0%:100%	*56%:44%*	*54%:46%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

On panel B, after-hours extreme prices fluctuation show significant mean reversion on period 1 highlighting winners triggers. In this case, the proportion of overreaction reversed in the following 24 hours after extreme price movements occur is equal to 46.91% and significant at the 1% level. Losers, on the other hand, experience a mean reversion equals to 14.86% in the following two periods.

The mean abnormal return differences between normal-hours and after-hours triggers could be found on table 41.

Table 41 - Test of differences in fixed income mean abnormal returns during bull market periods

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	0.06%	-3.32%	3.39%	(-0.06)
5% loser	0.38%	0.82%	-0.44%	(-4.47)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Although the mean difference between normal-hours and after-hours triggers being more pronounced among winners it has not statistically significance. On the other hand, the mean difference of losers is equal to -0.44% and significant at the 1% level.

The analysis by ETF types shows that international ETF experience greater response to extreme price fluctuations in both periods, being more expressive during after-hours period. However, all differences show no statistically significance, as presented on table 42.

Table 42 - Test of differences in fixed income mean abnormal returns between ETF types during bull market periods

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	Broad-Based ETF
Normal-hours Winners	2.57%	1.83%
Normal-hours Losers	0.71%	0.57%
After-hours Winners	-4.24%	-2.61%
After-hours Losers	1.98%	0.63%

Panel B. Differences of Abnormal Return

	AR intl - AR Broad-Based
Normal-hours Winners	0.74%
	(1.00)
Normal-hours Losers	0.14%
	(0.63)
After-hours Winners	-1.63%
	(-1.38)
After-hours Losers	1.35%
	(1.08)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

b) Overreaction on bear market periods

The results of bear market periods analysis are shown on table 43.

Table 43 - Abnormal returns following fixed income triggers during bear market periods

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A. Normal-hours						
Winners						
Trigger=>5%	8.09%	1.97%	-0.99%	0.98%	24.32%	12.07%
(N = 42)	(7.77)***	(1.45)	(-1.83)*	(-0.05)		
	100%:0%	*62%:38%*	*36%:64%*			
Losers						
Trigger<=-5%	-7.23%	0.61%	0.53%	1.14%	-8.45%	-15.80%
(N = 85)	(-7.25)***	(-0.46)	(0.82)	(0.16)		
	0%:100%	*62%:38%*	*58%:42%*			
Panel B. After-hours						
Winners						
Trigger=>5%	7.35%	-0.78%	0.48%	-0.30%	-10.55%	-4.04%
(N = 45)	(7.40)***	(-2.21)**	(0.51)	(-1.30)		
	100%:0%	*40%:60%*	*44%:56%*			
Losers						
Trigger<=-5%	-7.09%	1.97%	0.25%	2.22%	-27.82%	-31.35%
(N = 43)	(-5.04)***	(1.47)	(0.13)	(1.15)		
	0%:100%	*60%:40%*	*63%:37%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

During bear market periods, normal-hours winners do not experience mean reversion on the two periods following extreme price fluctuations. On the other hand, for the same period losers experience a mean reversion equals to 15.80%.

Comparing to bull market periods, after-hours winners experience a less pronounce response in bear market periods. On period 1, the results show a mean reversion equals to 10.55% and significance at the 5% level, with 60% of winners experiencing negative abnormal returns. On the other hand, losers experience greater degree of overreaction during bear market periods, with 27.82% of extreme mean abnormal return reverted on the following period.

Unlike bull market periods, after-hours losers experience, on average, higher overreaction degree than after-hours winners.

The mean abnormal return differences between normal-hours and after-hours periods are presented on table 44.

Table 44 - Test of differences in fixed income mean abnormal returns during bear market periods

Trigger	AR Following Normal-hours Trigger	AR Following After-hours Trigger	Mean Difference	T-statistic
5% winner	1.97%	-0.78%	2.74%	(-0.10)
5% loser	0.61%	1.97%	-1.36%	(-3.27)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Winners present a higher difference of mean abnormal return between both periods being equal to 2.74%, however with no statistically significance. In case of losers the mean difference is equal to -1.36% with significance at the 1% level.

The analysis by ETF type shows that both types do not experience mean abnormal return reversals in case of normal-hours winners. Additionally, both types show higher mean reversals during after-hours period. The results could be found on table 45.

Table 45 - Test of differences in fixed income mean abnormal returns between ETF types during bear market periods

Panel A. Summary of Abnormal return by Type following a 5% trigger

	International ETF	Broad-Based ETF
Normal-hours Winners	2.57%	1.83%
Normal-hours Losers	0.71%	0.57%
After-hours Winners	-0.78%	-0.77%
After-hours Losers	1.71%	2.07%

Panel B. Differences of Abnormal Return

	AR intl - AR Broad-Based
Normal-hours Winners	0.74%
	(0.99)
Normal-hours Losers	0.14%
	(-0.03)
After-hours Winners	-0.01%
	(0.90)
After-hours Losers	-0.37%
	(-3.09)***

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

As panel B shows, the mean abnormal return difference between both types, in case of after-hours losers, is equal to -0.37% and significant at the 1% level. Other differences are not statistically significant. A more detail results from this estimation could be found on annex I.

Overall, we observe a lower degree of overreaction in case of normal-hours extreme price movements in both periods. Nonetheless, we find some important differences between after-hours triggers. Winners shows greater mean reversion during bull market periods than during bear market periods. Losers, on the other hand, experience greater degree of overreaction during bear market periods.

These results suggest that during bull market periods as already pointed out investors are more optimistic, overestimating the positive results. On the other hand, during bear market periods, investors tend to be more pessimists about the evolution of the market, thus they tend to overestimate the negative results. The differences between two market sentiment periods are expressed on table 46.

Table 46 - Test of differences of fixed income mean reversions between bull and bear periods

	Normal-hours	**After-hours**
Winners	-1.90%	-2.55%
	(-0.48)	(0.06)
Losers	-0.23%	-1.16%
	(-0.38)	(-0.03)

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Differences are more pronounced among positive abnormal returns during normal-hours and after-hours periods. However, such differences are not statistically significant.

5. Conclusions

ETF is a quite recent financial market which has been developing at a huge pace over the last decade. Their characteristics of being easy to trade and low credit risk are attractive for investors. The first equity ETF appears in 1990 while non-equity ETF only appears in 2000. It is thus understandable the greater development of equity ETF market than others.

The financial crisis that emerged in 2007 was one of greatest event experienced by financial markets. It constitutes also a turning point for ETF industry with a great demand by investors since then. So, this study intends to analyse the behaviour of equity and fixed income markets returns during and after such event.

For that, we analyse the extreme price movements (higher than 5% or lower than -5%) occurred in US equity and fixed income market ETF between 2007 and 2014. Also, we segregate a 24 hours period in two different periods: normal-hours and after-hours period. The first includes the market open hours while the second period corresponds to the hours when the market is close. Both periods show different characteristics which may be translate in different trading behaviour. Therefore, the presence of overreaction is analysed over the first 24 hours, two periods, after extreme price movement occurs.

Our main conclusion is that both markets experience a greater level of overreaction following after-hours extreme abnormal returns. Moreover, we conclude, in some cases, an extension of normal-hours extreme abnormal returns in the following period instead of an expected correction. These results may have different interpretations. On the one hand, they may suggest the presence of an enough proportion between rational and uninformed/feedback traders during normal-hours period, disable irrational investors to create market anomalies. After-hours market is characterized by higher transaction costs which make such market less attractive for investors. Noise trades have, this way, more opportunities to influence the market. Additionally, liquidity levels are much higher on normal-hours than after-hours periods, being this period more sensible to deviation from fundamental value.

The multivariate models for equity and fixed income markets are consistent with these estimations results. In case of equity market, the model has a higher explanatory power on after-hours period than normal-hours period and shows that abnormal returns following extreme abnormal returns are sensible to the magnitude of trigger and their sign. We also conclude greater explanatory power in case of winners. Regarding fixed income market, we

achieve similar conclusions. Also in this market, we observe a greater explanatory power of the model in case of after-hours and winners triggers. Overall, the level of overreaction is, like in equity market, influenced by the magnitude and sign of triggers, but also by the abnormal volatility presented on the market. These findings are consistent with our previous hypothesis of higher efficiency level on ETF market during normal-hours. However, we also may discuss about a randomly influenced of noise traders on the market, being not possible distinguish ETF characteristics that allow to anticipate abnormal returns. As we referred before, these results could be object of different interpretations.

The analysis by ETF type also enables to conclude that, in case of equity market, international ETF experience the greatest level of overreaction during normal-hours period, and the lowest level during after-hours period. This could be justified by the composition of the underlying (foreign securities), being the information flow and the incorporation of it on price different from other types. Also, during after-hours period equity sector ETF experience higher level of overreaction which is in line with our expectation since it is the lowest diversified type. As already pointed out there are no fixed income sector ETF over our analysis period, so we focus on international and broad-based fixed-income ETF. We conclude that international ETF experience greater degree of overreaction than broad-based ETF regardless the period.

On a complementary basis, we analyse financial crisis and recovery period separately. Regarding equity market, the results enable to conclude that both period experienced an identical behaviour as previously discussed with more pronounced reversals following after-hours triggers. Comparing to recovery period, financial crisis period shows greater level of overreaction in both winners and losers following after-hours extreme price movements. On fixed income market, reversals are also small during normal-hours periods. After-hours losers experience greater response during financial crisis, but after-hours winners show larger reversals during recovery period. These findings are in line with expectations, in equity market, since financial crisis was a period characterized by greater volatility, thus higher probability to anomalies occurs. Fixed income reports mixed results, mainly between after-hours winners and losers. The lower volatility and development level of such market during financial market could influence such results.

In another extension of this study, we analyse the pattern of overreaction during bull and bear market periods. Regarding ETF equity market, we conclude greater level of overreaction during bear market periods. Comparing with losers, winners experience lower level of correction during bull market period, while during bear market periods they show the highest level of correction, on period 1. Regarding fixed income market, we find the same pattern with winners experience a greater response on bull market periods, while losers show a higher level of overreaction during bear market periods. Investors, during bull market periods are more optimistic, so they tend to overestimate positive movements. On the other hand, during bear market periods investors are more pessimists regarding the evolution of the market overestimating the negative movements.

Overall, we are able to conclude greater level of inefficiencies on after-hours market period. Financial crisis had a negative influence on this market, mainly in equity market.

In the present dissertation, we face some limitations that are important to refer. On the one hand, ETF fixed income market, during the analysis period, is characterized by low degree of development and low liquidity level which could affect the conclusions throughout this study. As a consequence, we obtained a more restrictive sample for this market comparing to equity ETF market. On the other hand, our study approaches such unique event on financial market, so the results could be different for other periods with lower volatility. Finally, the present study only analyse a possible reversion on the two following periods after extreme price movement occur, longer reversals are not captured.

The conclusions of this study are very interesting and constitutes a relevant contribute for the study of overreaction patterns on ETF industry. Forthcoming analysis may be relevant using other periods. Given the huge development of equity ETF market, further analysis approaching other markets beyond US market is also an important and relevant study that could be done. Finally, this study constitutes a first introduction of overreaction on fixed income market. Further analysis approaching such market will be interesting since, nowadays, this market is characterized by higher diversity and liquidity level with perspectives of continuing to grow.

6. Appendix

6.1. Appendix I – Bull and Bear Market methodology

In order to distinguish our analysis period between bull and bear market periods we apply the Pagan and Sossounov (2003) methodology. They defined bull market as a period of an increase on market prices, while bear market corresponds to periods when market price tends to decrease. This definition implies the existence of turning points when the market has gone from one phase to another. So firstly, it is necessary to determine these turning points and afterwards determine the periods. For that, authors defined some rules:

- The initial turning point should be the highest (lowest) value in a length of eight months.
- Selection of turning point alternating between highest peak and lowest troughs.
- Not consider turning point founded in the first and last six months of our series.
- Each cycle, a bull period plus a bear period, should have at least 16 months.
- Each phase should have duration of at least 4 months, except if price fall/rise more than 20%.

For equity market, we use the close prices of SP500 index, obtained from Bloomberg database, in order to estimate the bull and bear market between 2007 and 2014. We achieve a total of 5 phases during this period as shown on table 47.

Table 47 - Equity Market Sentiment Phases during 2007 and 2014

Period	Months	Phase
Jan 07 - Oct 07	10	Bull
Nov 07 -Jul 10	33	Bear
Aug-10-Apr 11	10	Bull
May 11 - Oct 11	5	Bear
Oct 11 - Dec 14	38	Bull

Regarding fixed income market, we apply the same methodology using a benchmark index from Bloomberg database: Bloomberg Barclays US Aggregate Bond Index (**Ticker Bloomberg**: LBUSTRUU Index). In this market, we obtained 7 phases during our analysis period, as are shown on table 51.

Table 48 - Fixed income market sentiment phases during 2007 and 2014

Period	Months	Phase
Jan 07 - Mar 08	15	Bull
Apr 08-Oct 08	6	Bear
Nov 08-Dec 09	11	Bull
Jan 10 - Jun 10	6	Bear
Jul 10 - Oct 12	28	Bull
Nov 12 - Jul 13	9	Bear
Aug 13 - Dec 14	17	Bull

6.2. Appendix II - Econometric Model

The analysis data vary across the time, so we start to apply a panel data analysis. Between panel data models, we conclude that random effects model is the most appropriate one, once we have time-invariant variable. It assumes that ETF's error term is not correlated with the predictors allowing time-invariant variables play a role of explanatory variable. Such conclusion was confirmed by Hausman test which test if the unique errors are correlated with repressors. If they are correlated, random effects model is the most appropriate test, otherwise it would be preferred to use fixed effects model.

However, if there is no significant differences across different ETF used in our sample, ordinary least squares (OLS) turns the model most appropriate to use, since there is no panel effect. Breusch-Pagan Lagrange multiplier tests if there are significant differences across ETF. Through that we conclude that there is no significant difference between different ETF used in our sample, thus OLS is model more suitable for our analysis. All model presents on this dissertation are corrected by heteroscedasticity.

Thus, the multivariate model for equity ETF market is the following:

$$\begin{aligned} AR_i = {} & \beta_0 + \beta_1 AFTERHOURS_i + \beta_2 LOSDUM_i + \beta_3 TRIGGER_i + \beta_4 INTLDUM_i \\ & + \beta_5 SECTDUM_i + \beta_6 ABN\_VOLATILITY_i + \beta_7 ANB\_VOLUME_i \\ & + \beta_8 BULLDUM_i + \beta_9 TAXDUM_i + \beta_{10} Year08 + \beta_{11} Year09 \\ & + \beta_{12} Year10 + \beta_{13} Year11 + \beta_{14} Year12 + \beta_{15} Year13 + \beta_{16} Year14 \\ & + \varepsilon_i \end{aligned}$$

The multivariate model applied in fixed income ETF market is the following:

$$\begin{aligned} AR_j = {} & \beta_0 + \beta_1 AFTERHOURS_i + \beta_2 LOSDUM_i + \beta_3 TRIGGER_i + \beta_4 INTLDUM_i \\ & + \beta_5 CORPDUM_i + \beta_6 ABN\_VOLATILITY_i + \beta_7 ABN\_VOLUME_i \\ & + \beta_8 BULLDUM_i + \beta_9 TAXDUM_i + \beta_{10} Year08 + \beta_{11} Year09 \\ & + \beta_{12} Year10 + \beta_{13} Year11 + \beta_{14} Year12 + \beta_{15} Year13 + \beta_{16} Year14 + \varepsilon_i \end{aligned}$$

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8. Annex

8.1. Annex I - Bull and Bear Market

Dividing our equity sample into bull and bear market, we obtained the following distribution of our observations:

Table 49 - Distribution of equity ETF sample that satisfies the 5% trigger divided by bull and bear market periods

	Winners				Losers				Total	
	Normal-hours		After-hours		Normal-hours		After-hours			
Bull Period										
International ETF	275	16%	515	30%	366	21%	577	33%	1733	100%
Broad-Based ETF	386	29%	259	19%	418	31%	279	21%	1342	100%
Sector ETF	592	33%	311	17%	621	34%	292	16%	1816	100%
Entire Sample	1253	26%	1085	22%	1405	29%	1148	23%	4891	100%
Bear Period										
International ETF	1499	21%	1793	25%	2092	30%	1682	24%	7066	100%
Broad-Based ETF	3179	32%	1645	16%	3747	37%	1508	15%	10079	100%
Sector ETF	4158	30%	2498	18%	5263	38%	2107	15%	14026	100%
Entire Sample	8836	28%	5936	19%	11102	36%	5297	17%	31171	100%

	Total Normal-hours		Total After-hours		Total Winners		Total Losers	
Bull Period								
International ETF	641	24%	1092	49%	790	34%	943	37%
Broad-Based ETF	804	30%	538	24%	645	28%	697	27%
Sector ETF	1213	46%	603	27%	903	39%	913	36%
Entire Sample	2658	100%	2233	100%	2338	100%	2553	100%
Bear Period								
International ETF	3591	18%	3475	31%	3292	22%	3774	23%
Broad-Based ETF	6926	35%	3153	28%	4824	33%	5255	32%
Sector ETFs	9421	47%	4605	41%	6656	45%	7370	45%
Entire Sample	19938	100%	11233	100%	14772	100%	16399	100%

The following tables, 50 and 51, show the results for the estimation of abnormal returns following extreme price movements by ETF types during bull and bear market periods.

Table 50 - Abnormal returns following equity triggers by ETF types during bull market periods

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of Reversion in the following period	Proportion of Reversion in the following 24 Hours period
Panel A – Normal-hours						
Winners						
International ETF	6.68%	-0.35%	-0.49%	-0.84%	-5.30%	-12.60%
(N = 275)	(16.24)***	(-2.19)**	(-2.77)***	(-3.66)***		
	100%;0%	*42%:58%*	*42%:58%*			
Broad Based ETF	6.72%	0.03%	-0.46%	-0.43%	0.51%	-6.34%
(N = 386)	(19.34)***	(-0.25)	(-3.11)***	(-2.46)**		
	100%;0%	*54%:46%*	*48%:52%*			
Sector ETF	6.75%	0.17%	-0.30%	-0.13%	2.57%	-1.93%
(N = 592)	(24.05)***	(0.73)	(-2.66)***	(-1.40)		
	100%;0%	*55%:45%*	*44%:56%*			
Losers						
International ETF	-6.47%	0.25%	0.46%	0.71%	-3.93%	-11.00%
(N = 366)	(-16.48)***	(1.04)	(2.46)**	(2.58)***		
	0%;100%	*54%:46%*	*55%:45%*			
Broad Based ETF	-6.52%	-0.12%	0.67%	0.54%	1.88%	-8.35%
(N = 418)	(-17.75)***	(-1.25)	(3.97)***	(1.97)**		
	0%;100%	*50%:50%*	*59%:41%*			
Sector ETF	-6.53%	0.08%	0.38%	0.47%	-1.28%	-7.19%
(N = 621)	(-21.69)***	(0.05)	(2.62)***	(1.98)**		
	0%;100%	*55%:45%*	*56%:44%*			
Panel B – After-hours						
Winners						
International ETF	6.76%	0.06%	-0.14%	-0.08%	0.95%	-1.12%
(N = 515)	(22.45)***	(-0.08)	(-1.32)	(-1.03)		
	100%;0%	*55%:45%*	*45%:55%*			
Broad Based ETF	6.68%	-0.43%	-0.32%	-0.75%	-6.36%	-11.17%
(N = 259)	(15.76)***	(-2.48)**	(-1.85)*	(-3.20)***		
	100%;0%	*50%:50%*	*47%:53%*			
Sector ETF	6.69%	-0.92%	-0.14%	-1.06%	-13.74%	-15.87%
(N = 311)	(17.28)***	(-5.39)***	(-1.04)	(-4.77)***		
	100%;0%	*52%:48%*	*44%:56%*			
Losers						
International ETF	-7.01%	0.14%	0.21%	0.34%	-1.95%	-4.90%
(N = 577)	(-22.53)***	(0.45)	(1.21)	(1.21)		
	0%;100%	*48%:52%*	*57%:43%*			
Broad Based ETF	-7.08%	0.68%	0.17%	0.85%	-9.67%	-12.02%
(N = 279)	(-15.82)***	(3.12)***	(0.63)	(2.78)***		
	0%;100%	*52%:48%*	*52%:48%*			
Sector ETF	-7.12%	1.21%	0.23%	1.43%	-16.95%	-20.13%
(N = 292)	(-16.28)***	(5.93)***	(0.97)	(5.12)***		
	0%;100%	55%:45%	59%:41%			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Table 51 - Abnormal returns following equity triggers by ETF types during bear market periods

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of Reversion in the following period	Proportion of Reversion in the following 24 Hours period
Panel A – Normal-hours						
Winners						
International ETF	7.57%	-0.02%	-0.60%	-0.63%	-0.28%	-8.26%
(N = 1499)	(35.73)***	(0.07)	(-5.71)***	(-4.01)***		
	100%;0%	*47%:53%*	*47%:53%*			
Broad Based ETF	7.63%	0.46%	-0.59%	-0.13%	6.00%	-1.75%
(N = 3179)	(52.40)***	(5.17)***	(-8.17)***	(-1.92)*		
	100%;0%	*50%:50%*	*49%:51%*			
Sector ETF	8.02%	0.34%	-0.68%	-0.33%	4.25%	-4.16%
(N = 4158)	(62.92)***	(4.49)***	(-10.41)***	(-4.02)***		
	100%;0%	*51%:49%*	*47%:53%*			
Losers						
International ETF	-7.34%	0.22%	0.55%	0.78%	-3.07%	-10.60%
(N = 2092)	(-37.42)***	(2.19)**	(3.75)***	(4.32)***		
	0%;100%	*54%:46%*	*60%:40%*			
Broad Based ETF	-7.63%	-0.32%	0.69%	0.37%	4.16%	-4.83%
(N = 3747)	(-52.13)***	(-3.28)***	(6.63)***	(2.25)**		
	0%;100%	*51%:49%*	*58%:42%*			
Sector ETF	-7.67%	0.04%	0.74%	0.78%	-0.49%	-10.15%
(N = 5263)	(-62.11)***	(0.93)	(8.66)***	(6.86)***		
	0%;100%	52%:48%	57%:43%			
Panel B – After-hours						
Winners						
International ETF	7.50%	-1.19%	-0.31%	-1.50%	-15.86%	-19.99%
(N = 1793)	(38.74)***	(-9.19)***	(-3.77)***	(-9.61)***		
	100%;0%	*46%:54%*	*45%:55%*			
Broad Based ETF	7.67%	-1.97%	-0.04%	-2.00%	-25.68%	-26.14%
(N = 1645)	(37.88)***	(-14.72)***	(-1.41)	(-12.08)***		
	100%;0%	*42%:58%*	*45%:55%*			
Sector ETF	7.72%	-2.57%	0.13%	-2.44%	-33.29%	-31.61%
(N = 2498)	(46.98)***	(-23.76)***	(-0.09)	(-17.96)***		
	100%;0%	*38%:62%*	*47%:53%*			
Losers						
International ETF	-7.42%	0.97%	0.58%	1.55%	-13.06%	-20.88%
(N = 1682)	(-33.96)***	(7.69)***	(3.59)***	(8.34)***		
	0%;100%	*58%:42%*	*58%:42%*			
Broad Based ETF	-7.56%	1.64%	0.45%	2.09%	-21.68%	-27.67%
(N = 1508)	(-32.78)***	(12.15)***	(2.41)**	(10.87)***		
	0%;100%	*61%:39%*	*54%:46%*			
Sector ETF	-7.84%	2.08%	0.45%	2.53%	-26.60%	-32.30%
(N = 2107)	(-40.22)***	(18.19)***	(2.80)***	(15.69)***		
	0%;100%	*64%:36%*	*53%:47%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Dividing our fixed income sample into bull and bear market, we obtain the following distribution of observation.

Table 52 - Distribution of fixed income ETF sample that satisfies the 5% trigger divided by bull and bear market periods

	Winners				Losers				Total	
	Normal-hours		After-hours		Normal-hours		After-hours			
Bull Period										
International ETFs	25	21%	37	31%	46	38%	12	10%	120	100%
Broad-Based ETFs	58	23%	48	19%	103	42%	38	15%	247	100%
Entire Sample	83	23%	85	23%	149	41%	50	14%	367	100%
Bear Period										
International ETFs	8	15%	11	20%	23	43%	12	22%	54	100%
Broad-Based ETFs	34	21%	34	21%	62	39%	31	19%	161	100%
Entire Sample	42	20%	45	21%	85	40%	43	20%	215	100%

	Total Normal-hours		Total After-hours		Total Winners		Total Losers	
Bull Period								
International ETFs	71	31%	49	36%	62	37%	58	29%
Broad-Based ETFs	161	69%	86	64%	106	63%	141	71%
Entire Sample	232	100%	135	100%	168	100%	199	100%
Bear Period								
International ETFs	31	24%	23	26%	19	22%	35	27%
Broad-Based ETFs	96	76%	65	74%	68	78%	93	73%
Entire Sample	127	100%	88	100%	87	100%	128	100%

The results of abnormal returns following extreme price movements by ETF types during bull and bear market periods are show in the following tables 53 e 54.

Table 53 - Abnormal returns following fixed income triggers by ETF types during bull market periods

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A – Normal-hours						
Winners						
International ETF	10.05%	2.57%	-1.93%	0.64%	25.52%	6.36%
(N = 25)	(6.70)***	(3.61)***	(-2.41)**	(1.01)		
	100%:0%	*52%:48%*	*52%:48%*			
Broad Based ETF	7.62%	1.83%	-0.77%	1.06%	23.95%	13.84%
(N = 58)	(7.89)***	(4.17)***	(-1.46)	(2.11)**		
	100%:0%	*43%:57%*	*55%:45%*			
Losers						
International ETF	-7.65%	0.71%	0.80%	1.51%	-9.33%	-19.73%
(N = 46)	(-5.97)***	(1.93)*	(1.37)	(2.43)**		
	0%;100%	*67%:33%*	*59%:41%*			
Broad Based ETF	-7.07%	0.57%	0.43%	1.01%	-8.09%	-14.22%
(N = 103)	(-8.19)***	(2.55)**	(1.13)	(2.72)***		
	0%;100%	*53%:47%*	*47%:53%*			
Panel B – After-hours						
Winners						
International ETF	7.93%	-4.24%	0.02%	-4.22%	-53.51%	-53.26%
(N = 37)	(6.53)***	(-5.39)***	(0.04)	(-4.04)***		
	100%:0%	*22%:78%*	*57%:43%*			
Broad Based ETF	6.87%	-2.61%	-0.22%	-2.83%	-38.07%	-41.25%
(N = 48)	(6.52)***	(-3.47)***	(-0.37)	(-2.88)***		
	100%:0%	*31%:69%*	*50%:50%*			
Losers						
International ETF	-7.49%	1.98%	1.13%	3.10%	-26.40%	-41.44%
(N = 12)	(-2.98)***	(2.02)**	(0.99)	(2.23)**		
	0%;100%	*83%:17%*	*75%:25%*			
Broad Based ETF	-7.09%	0.63%	-0.10%	0.52%	-8.82%	-7.35%
(N = 38)	(-4.99)***	(1.63)	(-0.15)	(1.12)		
	0%;100%	*47%:53%*	*47%:53%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Table 54 - Abnormal returns following fixed income triggers by ETF types during bear market periods

	Period 0	Period 1	Period 2	24Hours (Period 1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A – Normal-hours						
Winners						
International ETF	10.05%	2.57%	-1.93%	0.64%	25.52%	6.36%
(N = 8)	(4.11)***	(0.97)	(-1.44)	(-0.16)		
	100%:0%	*63%:38%*	*25%:75%*			
Broad Based ETF	7.62%	1.83%	-0.77%	1.06%	23.95%	13.84%
(N = 34)	(6.64)***	(1.14)	(-1.33)	(0.03)		
	100%:0%	*62%:38%*	*38%:62%*			
Losers						
International ETF	-7.65%	0.71%	0.80%	1.51%	-9.33%	-19.73%
(N = 23)	(-4.04)***	(-0.14)	(0.73)	(0.34)		
	0%;100%	*57%:43%*	*65%:35%*			
Broad Based ETF	-7.07%	0.57%	0.43%	1.01%	-8.09%	-14.22%
(N = 62)	(-6.04)***	(-0.45)	(0.51)	(-0.02)		
	0%;100%	*65%:35%*	*55%:45%*			
Panel B – After-hours						
Winners						
International ETF	8.09%	-0.78%	-0.74%	-1.52%	-9.67%	-18.76%
(N = 11)	(3.98)***	(-1.10)	(-0.73)	(-1.24)		
	100%:0%	*36%:64%*	*36%:64%*			
Broad Based ETF	7.11%	-0.77%	0.87%	0.10%	-10.88%	1.37%
(N = 34)	(6.25)***	(-1.92)*	(1.00)	(-0.79)		
	100%:0%	*41%:59%*	*47%:53%*			
Losers						
International ETF	-7.66%	1.71%	-0.23%	1.47%	-22.26%	-19.19%
(N = 12)	(-2.92)***	(0.59)	(-0.34)	(0.23)		
	0%;100%	*67%:33%*	*67%:33%*			
Broad Based ETF	-6.86%	2.07%	0.44%	2.51%	-30.22%	-36.61%
(N = 31)	(-4.12)***	(1.36)	(0.37)	(1.22)		
	0%;100%	*58%:42%*	*61%:39%*			

Proportion of positive observations: proportion of negative observations shown in italics
*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

8.2. Annex II - Tables from financial crisis and recovery period analysis

8.2.1. Equity Market

Table 55 - Distribution of equity ETF sample that satisfies the 5% trigger divided by financial crisis and recovery period

	Winners				Losers				Total	
	Normal-hours		After-hours		Normal-hours		After-hours			
Financial Crisis - October 9 2007 to March 9 2009										
International ETFs	1096	22%	1126	23%	1539	31%	1143	23%	4904	100%
Broad-Based ETFs	2249	31%	1164	16%	2719	38%	1091	15%	7223	100%
Sector ETFs	2713	29%	1650	17%	3616	38%	1472	16%	9451	100%
Entire Sample	6058	28%	3940	18%	7874	36%	3706	17%	21578	100%
Recovery Period -March 9,2009 to December 31, 2014										
International ETFs	672	17%	1177	30%	917	24%	1109	29%	3875	100%
Broad-Based ETFs	1287	31%	722	18%	1413	34%	687	17%	4104	100%
Sector ETFs	1993	32%	1141	18%	2237	36%	914	15%	6285	100%
Entire Sample	3952	28%	3040	21%	4567	32%	2710	19%	14264	100%

	Total Normal-hours		Total After-hours		Total Winners		Total Losers	
Financial Crisis - October 9 2007 to March 9 2009								
International ETFs	2635	19%	2269	30%	2222	22%	2682	23%
Broad-Based ETFs	4968	36%	2255	29%	3413	34%	3810	33%
Sector ETFs	6329	45%	3122	41%	4363	44%	5088	44%
Entire Sample	13932	100%	7646	100%	9998	100%	11580	100%
Recovery Period -March 9,2009 to December 31, 2014								
International ETFs	1589	11%	2286	30%	1849	18%	2026	17%
Broad-Based ETFs	2700	19%	1409	18%	2009	20%	2100	18%
Sector ETFs	4230	30%	2055	27%	3134	31%	3151	27%
Entire Sample	8519	100%	5750	100%	6992	100%	7277	100%

Table 56 - Abnormal returns following equity triggers by ETF types during financial crisis period

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A – Normal-hours						
Winners						
International ETF	7.75%	-0.08%	-0.61%	-0.69%	-1.04%	-8.91%
(N = 1096)	(30.66)***	(-0.32)	(-4.47)***	(-3.42)***		
	100%;0%	*45%:55%*	*47%:53%*			
Broad Based ETF	7.85%	0.62%	-0.65%	-0.02%	7.96%	-0.29%
(N = 2249)	(44.46)***	(5.40)***	(-6.75)***	(-0.69)		
	100%;0%	*50%:50%*	*48%:52%*			
Sector ETF	8.23%	0.44%	-0.67%	-0.22%	5.39%	-2.72%
(N = 2713)	(51.05)***	(4.28)***	(-7.60)***	(-2.15)**		
	100%;0%	*51%:49%*	*47%:53%*			
Losers						
International ETF	-7.41%	0.18%	0.55%	0.73%	-2.49%	-9.92%
(N = 1539)	(-30.36)***	(1.45)	(3.21)***	(3.38)***		
	0%;100%	*54%:46%*	*61%:39%*			
Broad Based ETF	-7.88%	-0.45%	0.66%	0.20%	5.77%	-2.58%
(N = 2719)	(-43.13)***	(-3.91)***	(5.33)***	(0.81)		
	0%;100%	*49%:51%*	*59%:41%*			
Sector ETF	-7.91%	-0.09%	0.49%	0.40%	1.15%	-5.03%
(N = 3616)	(-49.94)***	(-0.68)	(4.24)***	(2.49)**		
	0%;100%	*50%:50%*	*56%:44%*			
Panel B – After-hours						
Winners						
International ETF	7.58%	-1.23%	-0.24%	-1.47%	-16.17%	-19.35%
(N = 1126)	(30.43)***	(-7.04)***	(-2.22)**	(-6.92)***		
	100%;0%	*47%:53%*	*46%:54%*			
Broad Based ETF	8.05%	-2.85%	0.11%	-2.74%	-35.35%	-33.96%
(N = 1164)	(32.76)***	(-16.84)***	(-0.01)	(-12.78)***		
	100%;0%	*37%:63%*	*47%:53%*			
Sector ETF	8.03%	-3.08%	0.33%	-2.75%	-38.29%	-34.23%
(N = 1650)	(38.91)***	(-21.68)***	(1.62)	(-15.29)***		
	100%;0%	*35%:65%*	*50%:50%*			
Losers						
International ETF	-7.57%	1.40%	0.44%	1.84%	-18.49%	-24.34%
(N = 1143)	(-26.76)***	(8.43)***	(2.09)**	(7.88)***		
	0%;100%	*62%:38%*	*54%:46%*			
Broad Based ETF	-7.81%	2.57%	0.40%	2.97%	-32.91%	-38.02%
(N = 1091)	(-27.07)***	(15.01)***	(1.77)*	(12.65)***		
	0%;100%	*68%:32%*	*51%:49%*			
Sector ETF	-8.14%	2.42%	0.42%	2.84%	-29.73%	-34.93%
(N = 1472)	(-32.84)***	(16.42)***	(2.22)**	(14.04)***		
	0%;100%	*67%:33%*	*50%:50%*			

Proportion of positive observations: proportion of negative observations shown in italics

*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance

Table 57 - Abnormal returns following equity triggers by ETF types during recovery period

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours Period
Panel A – Normal-hours						
Winners						
International ETF	6.91%	-0.07%	-0.56%	-0.63%	-1.02%	-9.08%
(N = 672)	(24.18)***	(-0.41)	(-4.60)***	(-3.62)***		
	100%;0%	*48%:52%*	*46%:54%*			
Broad Based ETF	6.95%	0.04%	-0.46%	-0.41%	0.62%	-5.94%
(N = 1287)	(33.66)***	(0.44)	(-5.44)***	(-3.61)***		
	100%;0%	*49%:51%*	*50%:50%*			
Sector ETF	7.39%	0.13%	-0.59%	-0.46%	1.74%	-6.18%
(N = 1993)	(44.50)***	(1.51)	(-8.24)***	(-4.85)***		
	100%;0%	*52%:48%*	*45%:55%*			
Losers						
International ETF	-6.88%	0.30%	0.52%	0.83%	-4.43%	-12.02%
(N = 917)	(-27.49)***	(2.36)**	(2.88)***	(3.80)***		
	0%;100%	*54%:46%*	*56%:44%*			
Broad Based ETF	-6.83%	0.04%	0.71%	0.75%	-0.60%	-10.99%
(N = 1413)	(-33.86)***	(0.45)	(5.36)***	(4.19)***		
	0%;100%	*53%:47%*	*57%:43%*			
Sector ETF	-6.96%	0.27%	1.06%	1.33%	-3.83%	-19.05%
(N = 2237)	(-43.45)***	(3.22)***	(10.92)***	(10.24)***		
	0%;100%	*56%:44%*	*59%:41%*			
Panel B – After-hours						
Winners						
International ETF	7.11%	-0.60%	-0.31%	-0.91%	-8.49%	-12.80%
(N = 1177)	(32.90)***	(-5.12)***	(-3.91)***	(-6.56)***		
	100%;0%	*50%:50%*	*43%:57%*			
Broad Based ETF	6.69%	0.04%	-0.39%	-0.35%	0.61%	-5.18%
(N = 722)	(24.25)***	(0.32)	(-3.61)***	(-2.38)**		
	100%;0%	*55%:45%*	*41%:59%*			
Sector ETF	6.98%	-1.37%	-0.23%	-1.60%	-19.66%	-22.97%
(N = 1141)	(31.80)***	(-11.53)***	(-3.20)***	(-10.72)***		
	100%;0%	*46%:54%*	*43%:57%*			
Losers						
International ETF	-7.06%	0.06%	0.52%	0.58%	-0.85%	-8.15%
(N = 1109)	(-31.03)***	(0.55)	(3.11)***	(2.65)***		
	0%;100%	*49%:51%*	*61%:39%*			
Broad Based ETF	-6.88%	-0.34%	0.43%	0.09%	4.92%	-1.29%
(N = 687)	(-23.80)***	(-2.18)**	(1.87)*	(-0.24)		
	0%;100%	*46%:54%*	*58%:42%*			
Sector ETF	-7.11%	1.23%	0.42%	1.65%	-17.30%	-23.23%
(N = 914)	(-28.38)***	(9.34)***	(2.11)**	(8.34)***		
	0%;100%	*56%:44%*	*59%:41%*			

Proportion of positive observations: proportion of negative observations shown in italics
*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance

8.2.2.Fixed Income

Table 58 - Distribution of fixed income ETF sample that satisfies the 5% trigger divided by financial crisis and recovery period

	Winners				Losers				Total	
	Normal-hours		After-hours		Normal-hours		After-hours			
Financial Crisis Period - Oct 9,2007 to Mar 9, 2009										
International ETFs	23	21%	24	22%	46	42%	16	15%	109	100%
Broad-Based ETFs	41	22%	35	19%	87	47%	24	13%	187	100%
Entire Sample	64	22%	59	20%	133	45%	40	14%	296	100%
Recovery Period - Mar 9, 2009 to Dec 31, 2014										
International ETFs	10	16%	24	38%	22	34%	8	13%	64	100%
Broad-Based ETFs	51	23%	47	21%	78	35%	45	20%	221	100%
Entire Sample	61	21%	71	25%	100	35%	53	19%	285	100%

	Total Normal-hours		Total After-hours		Total Winners		Total Losers	
Financial Crisis Period - Oct 9,2007 to Mar 9, 2009								
International ETFs	69	35%	40	40%	47	38%	62	36%
Broad-Based ETFs	128	65%	59	60%	76	62%	111	64%
Entire Sample	197	100%	99	100%	123	100%	173	100%
Recovery Period - Mar 9, 2009 to Dec 31, 2014								
International ETFs	32	20%	32	26%	34	26%	30	20%
Broad-Based ETFs	129	80%	92	74%	98	74%	123	80%
Entire Sample	161	100%	124	100%	132	100%	153	100%

Table 59 - Abnormal returns following fixed income trigger by ETF types during financial crisis period

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A – Normal-hours						
Winners						
International ETF	8.44%	1.26%	-1.51%	-0.25%	14.95%	-2.94%
(N = 23)	(5.75)***	(0.60)	(-1.38)	(-0.55)		
	100%:0%	*48%:52%*	*35%:65%*			
Broad Based ETF	8.09%	1.72%	-0.71%	1.00%	21.22%	12.39%
(N = 41)	(7.40)***	(1.41)	(-0.81)	(0.40)		
	100%:0%	*66%:34%*	*49%:51%*			
Losers						
International ETF	-7.83%	0.92%	0.58%	1.50%	-11.81%	-19.21%
(N = 46)	(-5.73)***	(0.38)	(0.92)	(0.92)		
	0%:100%	*65%:35%*	*59%:41%*			
Broad Based ETF	-7.24%	0.19%	-0.37%	-0.18%	-2.66%	2.42%
(N = 87)	(-7.19)***	(-0.87)	(-0.53)	(-0.98)		
	0%:100%	*55%:45%*	*45%:55%*			
Panel B – After-hours						
Winners						
International ETF	7.98%	-1.73%	0.02%	-1.72%	-21.73%	-21.50%
(N = 24)	(5.59)***	(-2.40)**	(0.11)	(-1.60)		
	100%:0%	*29%:71%*	*50%:50%*			
Broad Based ETF	6.92%	-0.75%	1.01%	0.27%	-10.78%	3.87%
(N = 35)	(5.97)***	(-1.70)*	(1.33)	(-0.25)		
	0%:100%	*23%:77%*	*40%:60%*			
Losers						
International ETF	-7.68%	2.22%	0.45%	2.67%	-28.89%	-34.78%
(N = 16)	(-3.30)***	(1.29)	(0.44)	(1.21)		
	100%:0%	*75%:25%*	*75%:25%*			
Broad Based ETF	-7.23%	2.73%	0.00%	2.73%	-37.76%	-37.73%
(N = 24)	(-3.77)***	(2.10)**	(0.09)	(1.52)		
	0%:100%	*67%:33%*	*46%:54%*			

Proportion of positive observations: proportion of negative observations shown in italics
*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

Table 60 - Abnormal returns following fixed income trigger by ETF types during recovery period

	Period 0	Period 1	Period 2	24Hours (Period1-2)	Proportion of the Overreaction Reversed in the Following Period	Proportion of the Overreaction Reversed in the Following 24 Hours
Panel A – Normal-hours						
Winners						
International ETF	7.90%	0.50%	0.39%	0.89%	6.32%	11.21%
(N = 10)	(3.42)***	(0.89)	(0.20)	(0.84)		
	100%:0%	*40%:60%*	*40%:60%*			
Broad Based ETF	6.88%	-0.32%	0.01%	-0.31%	-4.72%	-4.53%
(N = 51)	(6.79)***	(0.58)	(-0.50)	(0.20)		
	100%:0%	*37%:63%*	*37%:63%*			
Losers						
International ETF	-7.71%	0.69%	0.87%	1.56%	-8.95%	-20.24%
(N = 22)	(-4.32)***	(1.53)	(1.10)	(1.87)*		
	0%;100%	*59%:41%*	*64%:36%*			
Broad Based ETF	-7.25%	0.42%	0.57%	0.99%	-5.76%	-13.58%
(N = 78)	(-7.62)***	(2.31)**	(1.13)	(2.52)**		
	0%;100%	*60%:40%*	*55%:45%*			
Panel B – After-hours						
Winners						
International ETF	7.95%	-5.16%	-0.32%	-5.49%	-64.97%	-69.05%
(N = 24)	(5.32)***	(-5.33)***	(-0.93)	(-4.88)***		
	100%:0%	*17%:83%*	*50%:50%*			
Broad Based ETF	7.00%	-2.67%	-0.35%	-3.02%	-38.19%	-43.16%
(N = 47)	(6.62)***	(-3.33)***	(-1.36)	(-3.49)***		
	100%:0%	*36%:64%*	*45%:55%*			
Losers						
International ETF	-6.87%	0.46%	0.24%	0.71%	-6.75%	-10.30%
(N = 8)	(-2.30)***	(0.77)	(0.04)	(0.65)		
	100%:0%	*75%:25%*	*63%:38%*			
Broad Based ETF	-7.38%	1.09%	0.43%	1.52%	-14.77%	-20.65%
(N = 45)	(-5.90)***	(2.84)***	(0.54)	(2.63)***		
	100%:0%	*44%:56%*	*58%:42%*			

Proportion of positive observations: proportion of negative observations shown in italics
*, ** and *** represents significance at the 10%, 5% and 1% levels, respectively using a 2-tailed test for significance.

8.3. Annex III - Data supporting figures

Table 61 - Equity mean reversion in the following two periods by year

	2007	2008	2009	2010	2011	2012	2013	2014
Winners	-1.70%	-0.96%	-1.24%	-0.90%	-0.30%	-0.58%	-0.51%	0.02%
	(322)	(8533)	(4057)	(1219)	(1960)	(425)	(274)	(320)
Losers	1.63%	0.98%	1.71%	0.62%	0.50%	0.85%	0.65%	-0.06%
	(346)	(9487)	(4331)	(1249)	(2323)	(469)	(336)	(411)

The number of observation in each year could be found in parentheses

Table 62 - Equity mean reversion following normal-hours triggers by year

	2007	2008	2009	2010	2011	2012	2013	2014
Normal-hours winners	-0.07%	-0.09%	-0.65%	-0.60%	-0.74%	-0.19%	-0.15%	0.44%
	(200)	(5202)	(2436)	(660)	(1026)	(212)	(170)	(183)
Normal-hours losers	0.63%	0.13%	1.69%	0.53%	1.01%	0.40%	0.36%	-0.43%
	(260)	(6419)	(3059)	(844)	(1218)	(252)	(205)	(250)

The number of observation in each year could be found in parentheses

Table 63 - Equity mean reversion following after-hours triggers by year

	2007	2008	2009	2010	2011	2012	2013	2014
After-hours winners	-4.36%	-2.32%	-2.12%	-1.26%	0.18%	-0.97%	-1.10%	-0.53%
	(122)	(3331)	(1621)	(559)	(933)	(213)	(104)	(137)
After-hours losers	4.65%	2.78%	1.76%	0.80%	-0.06%	1.37%	1.10%	0.50%
	(86)	(3068)	(1272)	(405)	(1105)	(217)	(131)	(161)

The number of observation in each year could be found in parentheses

Table 64 - Fixed income mean reversion in the following two periods by year

	2007	2008	2009	2010	2011	2012	2013	2014
Winners	-7.38%	0.73%	-2.47%	-4.68%	-0.72%	-1.48%	-1.58%	-1.04%
	(1)	(99)	(58)	(27)	(40)	(17)	(9)	(4)
Losers	1.11%	1.24%	0.68%	1.74%	0.31%	0.57%	0.54%	0.89%
	(3)	(125)	(76)	(39)	(48)	(21)	(9)	(6)

The number of observation in each year could be found in parentheses

Table 65 - Fixed Income mean reversion following after-hours triggers by year

	2007	2008	2009	2010	2011	2012	2013	2014
Normal-hours winners	-7.38%	1.21%	0.63%	-1.55%	-0.52%	-0.58%	-1.72%	-0.53%
	(1)	(50)	(27)	(13)	(22)	(7)	(3)	(2)
Normal-hours losers	1.11%	0.78%	0.43%	1.35%	0.73%	0.29%	1.99%	-0.79%
	(3)	(92)	(64)	(25)	(29)	(13)	(4)	(4)

The number of observation in each year could be found in parentheses

Table 66 - Fixed Income mean reversion following after-hours triggers by year

	2007	2008	2009	2010	2011	2012	2013	2014
After-hours winners	-	0.24%	-5.17%	-7.58%	-0.97%	-2.12%	-1.51%	-1.54%
	(0)	(49)	(31)	(14)	(18)	(10)	(6)	(2)
After-hours losers	-	2.52%	1.98%	2.44%	-0.32%	1.04%	-0.62%	4.25%
	(0)	(33)	(12)	(14)	(19)	(8)	(5)	(2)

The number of observation in each year could be found in parentheses